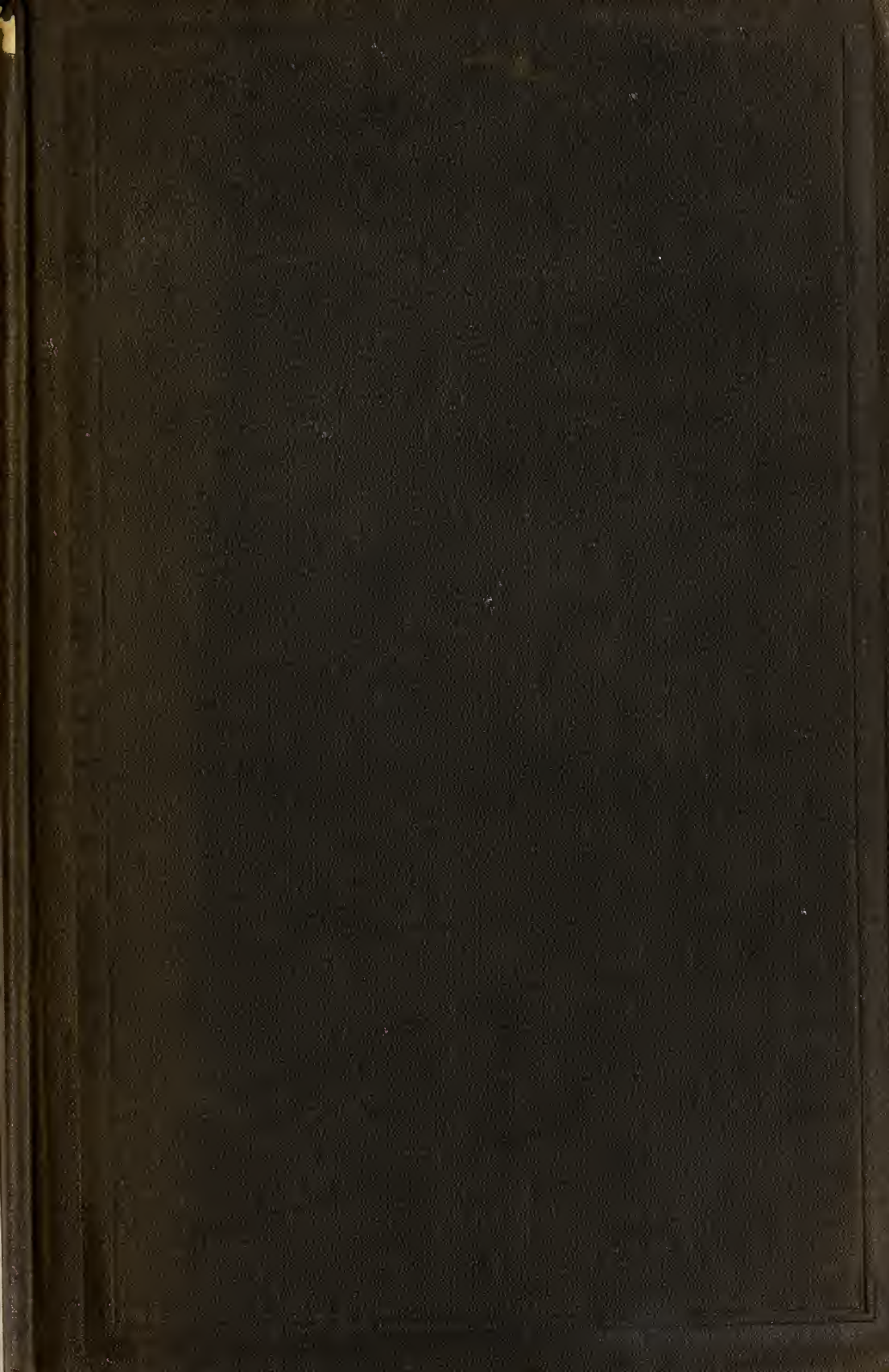


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REPORT
ON
FORESTRY,
SUBMITTED TO CONGRESS BY
THE COMMISSIONER OF AGRICULTURE.

PREPARED BY
FRANKLIN B. HOUGH.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1882.

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L E T T E R

FROM

THE COMMISSIONER OF AGRICULTURE,

TRANSMITTING

A Report on the Subject of Forestry.

MAY 12, 1882.—Referred to the Committee on Agriculture and ordered to be printed.
 JUNE 21, 1882.—Committee on Agriculture discharged, and referred to Committee on
 Printing.

UNITED STATES DEPARTMENT OF AGRICULTURE,
Washington, D. C., May 12, 1882.

SIR: In accordance with the provisions of the act establishing a Division of Forestry in this Department, I have the honor to transmit to Congress herewith a report on that subject by the Chief of the Division.

Very respectfully, your obedient servant,

GEO. B. LORING,
Commissioner of Agriculture.

Hon. J. WARREN KEIFER,
Speaker House of Representatives.



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REPORT UPON FORESTRY.

The law under which two previous Reports upon Forestry have been transmitted to Congress required certain specified points of inquiry to be made. In the first of these were embodied many practical suggestions having reference to forest-tree planting, a consideration of various scientific principles involved in the general subject of forestry, and a notice of various economies that find application in the industries employed in bringing forest products into market and in preparing them for use.

The second report presented very fully so much of the subject as related to the exportation and importation of forest products, going back to the beginning of a constitutional government in 1789, and presenting these data with as much fullness and uniformity as official records would allow. A principal object in covering so long a period was to show the rise and progress of this commerce in different sections of the country, its decay in regions where the supplies became exhausted, and its transfer to new localities as they became accessible by the opening of new avenues of transportation, and were demanded by new markets, or as they were found to be available for foreign trade. A careful study of these tables affords ample evidence of the necessity of making early and ample provision for future supplies by planting, reservation, and increased economy in consumption, if we would avoid the most serious inconveniences in the future. The existing timber regulations of the several provinces in Canada were also presented in the last report, with statistics showing the extent of the forest resources of that country, the amount of our transactions in these commodities, and the tendency of transportation through timber-slides, canals, and other public works.

PLAN OF PRESENT REPORT.

In the present Report we design to consider some of the measures deemed of highest importance for the promotion of our national welfare in regard to the maintenance of supplies and the acquiring and dissemination of facts having practical reference to the subject of forestry. In the course of these inquiries it is our purpose to present, so far as may be, the experience of other countries which, like our own, are looking forward to a time when the native supplies of timber will no longer meet the current and growing wants of this country and the demands of commerce, and when conservation and encouragement in planting will be among the imperative duties of the government. As this time approaches we shall begin to need the advantages that may be drawn from the experience of older countries, where improvidence and waste have long since done their work, and where, oftentimes under difficulties that might have been avoided with timely forethought, methods have been devised and successfully applied for supplying these important wants.

In the present report we deem it of first importance that attention should be especially called to the neglected condition of the timber still remaining upon the public domain, and will suggest a plan of management tending to their maintenance for present and future use.

The subject of experimental forest stations will be considered in detail, and suggestions made as to their location and management.

The subject of forest-fires is one of exceeding importance, as in some years causing a greater destruction to the forests than that occasioned by all the demands of industry put together; and during the past summer we have had renewed experience in these fearful calamities in the destruction of property and of life. In view of the importance of this subject, a circular was issued from the Department of Agriculture some months since, to collect from correspondents such facts and suggestions as appeared to deserve notice. Many data have been procured from other sources, and the statutes of the various States and Territories of this country have been carefully examined, with the view of collecting and comparing their provisions, and especially to ascertain the measures proposed for preventing their occurrence or lessening their damages. The results of these inquiries are given in the present report. Even in cases where these calamities occur from causes wholly beyond our control, as in some that we notice in detail, it is desirable that their possibility should be realized, for we must at least take into account these losses in our estimates for the future, and allow for the amount of timber thus lost, in addition to that of probable demand for use. The use of charcoal for metallurgical purposes, and of barks for tanning, have also been made subjects of special inquiry.

PROBABILITIES OF FUTURE TIMBER SUPPLY.

In looking forward to the probabilities of future supply of timber, we cannot expect (unless so far as may be derived from Canada) any assistance worth noticing from foreign countries, and must substantially depend upon ourselves for whatever we may require to meet the vast and varied wants of our population. Although in some instances the consumption may become less, as from the substitution of iron in civil and naval architecture, or of mineral coal for fuel, we can scarcely expect that the general demand will ever decrease; but that it will steadily advance with our increase in wealth and numbers, and that its supply must depend upon growth within our own territory, and, as the native timber is exhausted, it must in a great degree be reared under the care and protection of man.

It is indeed true that timber will grow through man's neglect wherever the soil and climate do not forbid, but with due forethought and intelligent care there is no cultivation that better repays the attention bestowed upon it than that of forest trees.

As a general rule, trees will flourish in any region that was covered by a native forest growth at the time of the first settlement of the country by Europeans, and upon our prairies and plains wherever grain of any kind can be cultivated without irrigation. The exceptions to this occur where, from forest fires, the organic materials in the soil have been so effectually burned up that nothing will grow until fertility is gradually restored by vegetable growth; or where, from the removal of forests, the soil has been exposed to climatic conditions that render planting difficult or altogether impossible. In some regions where forest trees are possible, the range of adaptation may be narrow, and not unfrequently success may be limited to one, or at most a very few, species.

To discover this range and limit, and to practically apply the facts when known to the fullest extent and effect, constitute the principal aim of forestry.

The work of practical cultivation and protection must, evidently, be undertaken by the owners of the land. It is among the plainest of principles, that neither the General Government, nor a State or a local municipality, will ever spend its means in planting upon lands where the title is vested in private owners, or that a private owner will ever care for premises not his own. It may be added that no tenant will ever be expected to plant lands where he is not to realize profits from the improvement, and that in general the cultivation of woodlands for a future supply, implies a stability of ownership and a faith in the certainty of returns, which, although it may not be inviting to speculation, is still a positive and easily computed addition to the wealth of the owner, reasonably sure in realization and profitable in amount.

PRINCIPAL DIVISIONS OF THE SUBJECT.

Applying these principles to the General Government, we may remark that its duty with reference to the future welfare of the country as regards forest supplies may be stated under the two following headings:

1st. As regards the care of forests upon the public lands, or their cultivation upon lands still belonging to the public domain; and

2d. The collection, determination, and diffusion of facts having practical application to forest culture, for the benefit of those who may wish to apply them in the management of private estates, and the promotion of researches tending to enlarge the boundaries of our knowledge in the sciences that concern this subject. Under this head we would include a careful examination of the results of experiments and observations as they are published from time to time in Europe, with the view of availing ourselves of so much of these as may appear applicable within our own country. We will separately consider these questions with some detail.

I.—WITH RESPECT TO THE CARE OF FORESTS UPON THE PUBLIC LANDS, OR THEIR CULTIVATION UPON LANDS STILL BELONGING TO THE PUBLIC DOMAIN.

It has been the policy of the government for many years to encourage settlement upon the public lands, and to pass the titles to private ownership, with the view of developing the resources of the country with as little delay as practicable. To this end it has subsidized railroad companies by granting alternate sections of the land along their routes. It has freely granted large tracts for the erection of public buildings, the endowment of institutions, the maintenance of schools, and the construction of various internal improvements. After offering its lands for sale at a price merely nominal for a long period, it has in recent years given land without price to the actual settler, and, for the encouragement of tree planting and irrigation it has offered still other portions upon terms easy of compliance to all who will accept them.

Within the present limits of the original States the General Government has never owned lands, excepting in very limited areas and for certain specified uses. The public lands once belonging to or still owned by the United States, acquired by cession, conquest, and purchase originally amounted to about 2,835,606 square miles, of which a little over 40 per cent. have been surveyed. More than one-third of

the unsurveyed part is included in Alaska, and much the greater part of the remainder is among the mountains in the Territories. A considerable portion of the lands now unsurveyed, and some that have been subdivided, will never be available for any kind of agriculture.

The amount of forest land, as well surveyed as unsurveyed, cannot be stated from any information within our knowledge, but it must be quite considerable, although much of it is at present remote from lines of transportation and unavailable for present use.

1.—FORESTS IN THE MOUNTAIN REGION: PLANS ELSEWHERE APPLIED.

The forests in the region of the Rocky Mountains, where not already disturbed by man or injured by fires, are found growing chiefly in the cañons and the basins and valleys that occur along their course before rising to the "timber line." The principal valleys have laterals coming in from either side, and these more or less subdivide as we follow them up. At the source of these streams we often find small ponds, fed by the rains and melting snows, and sometimes these ponds or little lakes are surrounded by level timber tracts inclosed by still higher mountains on nearly every side.

Wherever there is soil and a slope that is not too abrupt we find the timber, chiefly of the coniferous kinds, covering the sides of these valleys up to the limits of vegetation, and towards the more elevated regions the conifers are often found to give place to the quaking aspen, which shows a tendency to succeed the evergreens where the latter have been destroyed by fire. This alternation of species, where not controlled by human agencies, and sometimes in a manner that can scarcely be prevented, is very frequently observed in other situations, and many theories have been offered to account for its cause. None of them appear fully satisfactory, and the fact must remain on the list of phenomena to be determined by future research.

The pines, cedars, and firs of the mountain regions grow most luxuriantly in the lower valleys and most thriftily upon the south sides of the valleys running east and west, where they are more sheltered from the drying effects of the sun, and where the winter snows keep the ground moist for a longer period in spring. In these humid and sheltered situations the growth of these conifers is sometimes remarkable. Upon the rugged and rocky declivities the mountain mahogany (*Cercocarpus ledifolius*) is found scattered here and there, in clumps and singly, never occurring in dense groves of any considerable extent, but often in situations altogether inaccessible to man. Its foliage is perennial, but it has every quality that fits it for the extreme rigors of winter, and its growth is so slow that many centuries are required to bring it to the largest size. Its wood is exceedingly hard and dense, rendering it most expensive to transport and most difficult to work.

(a.) *Lumbering Operations—how carried on.*

The streams that flow through these valleys and gorges are seldom floatable for large timber or lumber, except when turned into flumes¹, and the great density of some of the kinds of timber found growing in these regions would not allow it to float itself if convenient opportunities for rafting were presented.

¹ Railroad ties and cord wood have been floated to some extent, but the opportunities are exceptional rather than common.

The streams often afford abundant water and good facilities for the location of saw-mills, but the brief summer season allows but scanty opportunities for lumbering, and in winter there are none whatever, as the valleys are then generally closed altogether, and the deep snows and frequent snow-slides would render traveling, if attempted, both difficult and dangerous, and the accumulation of stock for summer work altogether impossible.

The broad swells of land forming the "divides" between the waters of different river-systems are generally of moderate slope and well timbered. Upon these and in the more level regions lumbering operations can sometimes be carried on in winter. In all cases the lumberman finds it to his interest to work up his stock, whether hewn or sawn, as his work progresses, instead of accumulating a large supply for a season more favorable for its manufacture, as in the pineries of the older States.

The mills most commonly used are portable, with one circular saw driven by steam power, and are moved to a new site from time to time, as the supplies around them are used up. There is seldom any attention given to the seasoning of lumber before being sent to a market, and, excepting in flumes, there is generally no great amount of capital invested in the lumbering business in any locality among the mountains. The expenses of transportation of logs to the mill, and of lumber to the market, are often very great, and as these establishments are generally small, the labor-saving appliances for handling and working lumber, that we find at such great lumbering centers as Saginaw or Williamsport, in the United States, or at Ottawa, in Canada, are wholly unknown. Their place is supplied by hand-labor, and the cost of production is necessarily high. In fact, the market price of native lumber is generally so high that upon railroad lines it has hitherto often been found cheaper to bring lumber or manufactured stock from the Mississippi River or the Pacific coast. Thus we find the sugar-pine and the redwood of the Sierras and the Coast Range, and the white pine of Wisconsin and Michigan, in the lumber markets of Salt Lake City and Denver, at prices lower than the best grades of lumber from the mountains, and of a quality which for some uses is better than any that the latter can afford.

This remark, however, applies only to lumber of the finer grades for finishing, and manufactured stuff.

(b.) Timber used for Mining Purposes.

The whole of the mining timbers, of which enormous quantities are required, and all of the wood used for fuel and charcoal, has hitherto been supplied from the nearest accessible woodlands, but at a great and greatly increasing cost. In fact there is nothing that, in the near future, threatens so serious an injury to the mining interests of these regions as the reckless and improvident destruction of the native timber. As an evidence of this, the prices have already reached in some places a degree that seriously burdens the mining industries of that region, and the difficulties are constantly becoming worse, and without the remotest prospect of amendment in the present course of abandonment and neglect.

As for qualities of strength and durability, the heavy firs and pines of the mountains compare favorably with those of other regions, and their durability might doubtless be very much increased by the processes hitherto employed in Europe for this purpose, but we are not

aware that any of these have as yet been introduced, beyond an experimental way, in the mining districts of the interior. As the cost of material increases, this item of economy must necessarily receive attention, where works of permanence are desirable in damp situations.

As for the right of property in the timber of the mountains, few questions have hitherto been asked, and it has been taken from the public lands wherever found. Excepting to the very limited extent to which efforts for its protection have been recently made by the agents of the Department of the Interior, no returns have ever been made as to the amount taken, and but a feeble income, as compared with consumption, has been derived from the penalties recovered on account of this spoliation of timber upon the public lands. As a rule, the first who came had the first chance, and in some cases an understanding was had between different operators by which each was to have the exclusive cutting upon certain portions without hinderance from the other. In other instances a collision of interests has arisen, which, as both parties were alike trespassers before the law, could scarcely be settled by the courts, or otherwise than by appeal to force. Instances of bloodshed and violence have happened time and again from the efforts of parties to monopolize timber, or to exclude competitors, and in other cases immense quantities of trees have been felled for speculative purposes, either to secure a right of possession, that might be sold at an advance, or to supply a prospective demand that never came. In both cases, large quantities thus felled have sometimes been left to rot upon the ground. In other cases, the disappointed contestant for an opportunity to cut timber has revenged his fancied injury by maliciously setting fire to the timber of his rival, and thus a hundred fold greater damage has been done to the country than if both had done their utmost towards depleting the forests by the usual operations of lumbering.

In many other regions remote from mining operations, or other inducements for spoliation, the forests among the mountains still remain undisturbed in their native abundance, no occasion having arisen for plunder, and no pretext for appropriation. Destructive fires have at various periods overrun immense regions, and in other places a new, and sometimes a different species, often uniform as to kind and age, but inferior in value, has sprang up to mark the extent of these former fires.

(c.) Necessity for Measures tending to Economize and Renew the Supply.

Admitting as a fact that much of this timber upon the public domain is now at full maturity and much of it passing to decay—that it is alike necessary and proper that such timber should be used to the greatest advantage, as a matter of public economy, for supplying the wants of the present time—we deem it the highest degree of folly to overlook the fact, that there are extensive growths of young timber being every year wasted and destroyed, while still of comparatively little worth, and gaining in value every year; that in the woodlands thus cut away or destroyed there is a tendency to reproduction, if cared for, that is lost through our neglect, and that a future generation will need these supplies much more than we can now realize or compute.

(d.) Probable Acceptability of a Judicious Law for Regulation of Timber.

Having made extensive journeys through these regions and obtained the views of many persons who are most largely concerned in the lumbering operations, we are well assured that a law, having for its object

a restraint upon waste, economy in use, and the reservation of certain obvious rights for the future, while it had due regard for the needs of the present, would meet with full acceptance and support. The parties who are immediately interested in the subject generally declare their preference for a privilege derived from law to one derived from no right, because they would then have the law for protecting them in its enjoyment; and they express their confident belief that if a privilege were granted for the exclusive use of a given tract of woodland upon payment of a reasonable price, the resources thus secured would be used with far greater prudence and economy than can now be realized in the absence of such privilege and right.

While much has been said about the reckless disregard of rights of property in the public domain, resulting generally from the total absence of protection, it has been shown many times that the prevailing sentiment in these regions is on the side of law and order, wherever these rights are properly defined and reasonably secured by law.

No difficulty has been found in the enjoyment of rights under our mining laws, or under other grants of privilege, throughout the whole extent of our Territories, and no reason can be foreseen that should render a legal grant of right in the working of a timber-claim more difficult than these to maintain, or any conditions that might accompany it less likely to be observed. In the absence of all experience, the first enactments, however carefully prepared, might be found to have defects that would need amendment; but under careful and judicious administration these faults would be noticed, and their remedy devised.

(e.) As to what can be Learned from the Experience of other Countries.

In these first enactments, we might profitably consider the action taken in other countries where, from similarity of conditions, we might naturally expect similar results.

In British India, in the Australian colonies, and in New Zealand, where extensive tracts of native timber were found for the first supply of European settlers, the same improvident waste occurred upon the public lands as with us. These resources were found to be rapidly wasting away, while no care was taken for their reproduction, until disastrous consequences in the near future became apparent, and the local government have in recent years been actively engaged in considering the measures for arresting this waste.

As the result of a study made under the advice of the best experience of Europe, systems of management have been advised, and to a certain extent applied. The details of these systems we propose to give elsewhere in these reports, and we deem them worthy of a careful study, as suggesting facts and principles worthy of our attention, under circumstances closely analogous to our own. The difficulties in our way are even much less than in some of these new and forming administrations of the forest service, especially in India, where a dense native population have, from time immemorial, enjoyed rights of usage in cultivation and pasture wholly inconsistent with successful forest culture, and where ancient prejudices, and inveterate abuses of various kinds, must be conciliated and overcome before permanent success is assured.

(f.) General Outline of the New Systems of Forest Management.

As a general rule, these plans of forest management contemplate a centralized direction, a local supervision directly responsible to the central

authority and acting under its direction, and the reservation of extensive tracts of existing timber lands still belonging to the government. These lands are withdrawn from sale or settlement and set apart for forest management; the present supply of timber suitable for use, and of full maturity, being opened for sale under regulations tending to economical use, and to the yielding of a revenue reasonably proportioned to its worth, but not oppressive in degree. For the great body of these native timber lands the supervision is limited at first to the sale of privileges for cutting timber, under the limitations prescribed, the title of the land being still retained by the government for such future improvement as it may find it proper to undertake.

A portion of these public lands, relatively small at first, but increasing every year as experience leads and the means allow, is inclosed and put under forest management by planting, thinning, and other improvement, the intention being to extend this cultivation so as ultimately to meet the full requirements of the future, when the native supply is gone.

Experiments in acclimatization, and nurseries for the propagation of valuable species, form an essential feature in these undertakings, and efforts are made to widely disseminate a knowledge of all improvements, and to encourage private enterprise in forest planting.

(g.) *Modes of Timber Management in Canada.*

By reference to the details of management of the public timber lands in Canada, as given in this and in a preceding volume,¹ it will be seen that although the system there in use is crude in its provisions and wholly destitute of any policy tending to secure the growth of new forests, it still yields a considerable revenue to the government above the cost of management. It has, however, this important feature: The title to the land itself remains vested in the government, and after the expiration of the first temporary leases under which the native timber is cut, it will be available for any course of management that experience may suggest. This last consideration prepares the way for any system of forestry that the wants and resources of the country may in future demand; and even without a system, the natural growth of a new forest where the old has been cut away, especially where the spruce timber prevailed, is, in many places, bringing forward a supply for future use, although much less effectually than under proper care would be obtained.

2.—PROPOSED RESERVATION OF TIMBER LANDS.

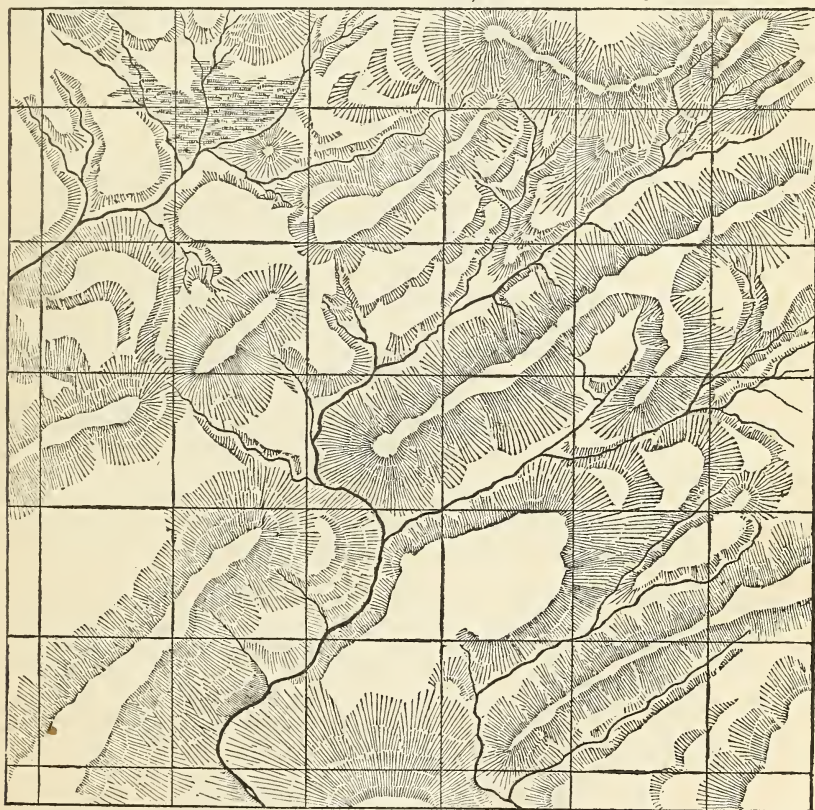
We would therefore earnestly recommend *that the principal bodies of timber land still remaining the property of the government (to be specified and described upon particular examination) be withdrawn from sale or grant under the existing modes for conveying the public lands, and that they be placed under regulations calculated to secure an economical use of the existing timber, and a proper revenue from its sale, the title being retained by the Government, and the young timber, in all leases for cutting, being reserved and protected for a future supply.*

One of the first objections that may be raised against this plan is, that it would require a previous survey of the land into sections, a labor that is far from being accomplished in the remoter parts of the Territories, and particularly expensive in mountainous regions.

¹ *Forestry Report*, vol. ii, pp. 439-605.

(a.) *The System of Public Land Surveys not Applicable to Timber-Working in Mountainous Regions.*

It has been decided that the system of surveys begun in the early years of our government, and since continued with but little change of plan, until it has covered the greater part of our territory, shall not be modified by differences of surface, but that it shall be extended alike over the mountains and the plains, thereby fixing with precision the location of all property, whether agricultural, mining, or otherwise, so that no uncertainty as to location or boundaries could in any manner arise. In this system, referring to certain Base Lines and Principal Meridians as a guide to the location, the surveys are carried uniformly over the whole surface, dividing it first into townships of six miles square, containing thirty-six sections each, and the sections are then subdivided down to quarters of quarters, or lots of forty acres each.



It will at once be understood that this system of surveys, however admirable and convenient for concise and accurate description and record, and for the general purposes of agriculture in a level country, would in a broken and mountainous region present the greatest difficulties in the location of lines of property for convenient occupation and profitable use. The division of property, or of privilege, must in such regions be governed by the boundaries of nature, such as dividing crests, the bottom of valleys, shores, or such other lines as the circumstances of the locality favor. To illustrate this idea, we present a topographical sketch, in which a mountainous region is overlaid by the

regular lines of the government surveys. There may occur ridges of hills and mountains, lines of morass, or rocky ravines dividing the sections into parts that, for all purposes of forestry, could never be managed with convenience, until the ownership was made to correspond with natural features of the surface, however different this might be from the Government survey.

It will be seen at a glance that such a survey, if made with the utmost care, would prove of very little practical use in marking timber limits, for no logs or lumber would ever be drawn over a dividing ridge, or up the steep sides of a deep valley; nor would it be possible in a single instance, to divert the delivery from the channel which nature had marked for its outlet.

We may therefore assume that township and section lines, in a rugged and broken region, will be useful only so far as they may specify the location of certain points, and that there can be no boundaries recognized in the sale of timber privileges but the dividing crests of ridges, the bottoms of valleys, or other natural and easily described lines subordinate to the natural topography of the surface.

(b.) *A System of Management may be established before Linear Surveys are made.*

It would not be difficult, therefore, *without a previous survey*, to subdivide the whole of our timber region in the mountains into districts of convenient size, whose limits might be easily described, and could not well be mistaken. In the absence of clearly defined crests, or other lines, a division line marked upon trees, or otherwise, as most convenient for description and least liable to mistake, would afford sufficient boundaries in many cases.

The kind and quality of the timber in a given subdivision, the difficulties of its extraction, and other facts should be known by the official who had charge of the district before the terms of sale were fixed.

As lumber in every form is a commodity that is bulky in proportion to its value, it cannot be taken from the localities where it has grown, excepting along some floatable stream, a flume, a railway, or a wagon-road of most convenient grades. It cannot be conveniently hidden from observation, and often the whole production for a large district of country would be obliged to pass a given point before reaching the markets.

The collection of dues would not therefore be difficult, and even where the accuracy of reports depended upon a sworn certificate alone, there are means afforded in the number and size of the stumps, which the owner of the privilege has left in his cuttings, for verifying the correctness of his returns. It would also be easy to prove in like manner any violation of the contract for the reservation of small trees, or in passing the boundaries prescribed in the lease.

(c.) *Defense of Rights under a Legal Title.*

It is assumed, and cannot well be doubted, that a man who had acquired the legal right to the exclusive privilege of cutting timber upon a given tract, has from the moment, and so long as his privilege continues, an interest in preventing all waste; and with the law on his side, he would most assuredly protect himself against all trespass. With the system once fairly established, he would have the sympathies and support of the lovers of law and order as fully as in the protection of any other kinds of property. It would be for his interest to impose stringent regulations among his men with regard to fires, and to organize measures for the prevention of their spread when started. In short,

it would tend to diminish that lawless disregard of public rights, resulting from the exposure of public property without protection to the plunder of whoever chooses to seize it, that has too long been the reproach of our frontier settlements, and to bring about the time when the ownership of property of every kind, as well private as public, shall be fully protected by law.

The salutary effect of this result alone deserves the thoughtful attention of every good citizen, and even if the revenue were no more than enough to pay the expenses, the result would render it worthy of public favor. It is scarcely expected that a measure involving many difficulties could be at once fully organized and put in operation, or that a plan involving so many points, however well considered, would not be found to need some modification when tested by experience. It should be applied first to the regions where lumber is being taken without authority from the public domains, for exportation or other extensive uses, and where for this reason the urgency is greater, and afterwards, as found possible, to the remaining reservations.

(d.) The Wants of First Settlers and their Supplies.

It might be a measure of policy, rather than of absolute right, to insert a provision favoring the actual settler, by supplying him with timber from lands not his own, to the limit of his own wants, or at least to give him preference upon the most favored terms in the sales from timber lands most convenient for his supply. It would be better if this right of usage were limited as to time, as it might become a serious inconvenience if allowed to gain the tenure of a long-established right. The pioneers of a new settlement encounter difficulties that disappear before their improvements, and their condition may require indulgences that could not be claimed with equal justice as the region becomes settled. It is equally necessary that in beginning a system of management, where everything must be organized from the foundation, that it should be as free from objections as may be, to those who are first to come under its provisions, and that it should be acceptable to those who as jurymen would be called upon to decide in case of prosecutions that might be brought under it. It is mentioned as a measure of temporary expediency that should be carefully regulated when its operation came to be better understood.

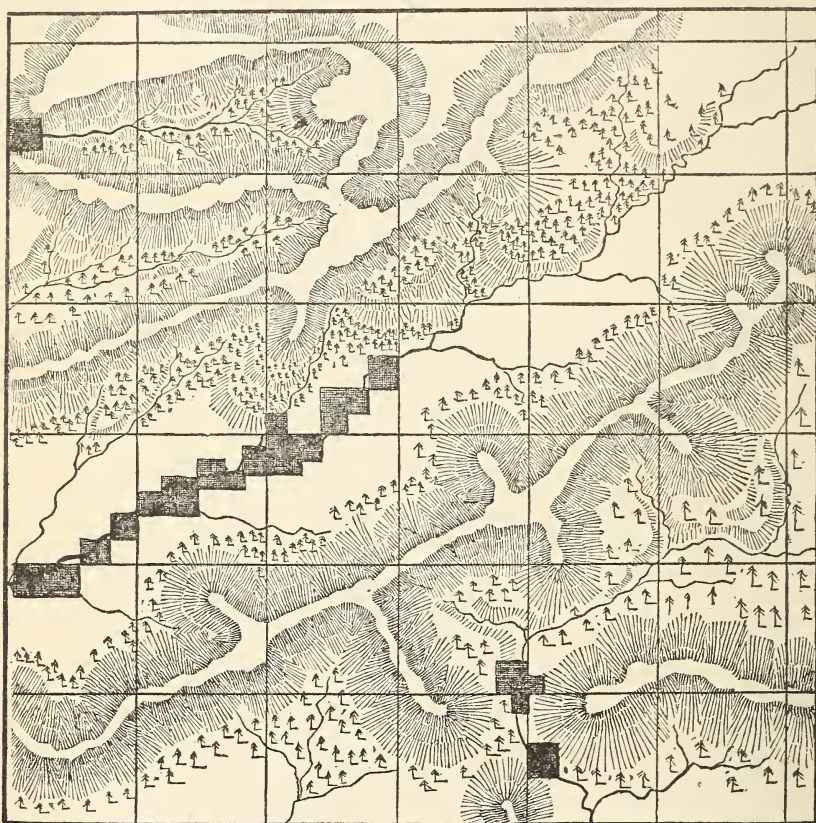
(e.) The lease of Privileges should be Annual ; Rights of Renewal.

The privileges of cutting timber should be by annual lease, with right of renewal upon certain conditions specified. There should be no renewals without an inspection for the purpose of learning that all the conditions had been observed, nor until all arrears of payment had been made. The Administration should have the right to terminate the occupation at any time, for sufficient cause, and the parties holding these privileges should give bonds for the payment of all dues and damages that might arise from their occupation.

(f.) Difficulties that have already arisen by prior Occupation and the Abuses resulting therefrom.

A source of difficulty has already arisen in reference to the timber upon the public lands lying in mountain valleys, which should be mentioned in this connection. In many instances the bottom-lands of these valleys have been entered under existing laws, in forty-acre parcels or more in a place, wherever it was thought possible to make any use of those lands for agricultural or pastoral purposes, and settlement has often been made upon them. The claims do not extend up from the bottom

of the valley farther than is necessary to include the tract taken, *and the right to the timber farther up the slopes of the mountains, is often claimed exclusively by the owners of the bottom of the valley.* It certainly can never be taken out without crossing these lands, and a right of way can only be obtained in a legal way at an expense much greater than those who might acquire a legal right to the timber could under existing laws afford to pay. These pretended owners of privilege pay no taxes upon the forest land over which they thus claim the exclusive right of enjoyment, nor could any assessment against them be enforced by law.



In other cases persons have assumed the monopoly of pasturage in valleys by acquiring a title to the land across the outlet, and sometimes without a shadow of title beyond that of occupation. There are still other instances where the future want of water for irrigation may render it desirable to establish reservoirs in the lower part of these valleys, rendering access difficult, and the extraction of timber very expensive or altogether impossible.

3.—DIFFERENT MODES OF PAYMENT FOR PRIVILEGES CONSIDERED.

There are three modes of payment applicable to the sale of privileges for cutting timber as above recommended, viz :

(a.) *Δ Ground-Rent.*—Depending upon the area leased, and to be paid annually in advance, or at least amply secured for payment whether the privilege be improved or not. Without being oppressive, it should

be of sufficient amount to prevent the holder from retaining more than he could occupy, and this would probably tend to prevent the monopolies that might otherwise arise with the view of controlling market prices within the region supplied.

(1.) *The Necessity and Justice of giving Rights of Renewal.*

It might frequently happen that the improvement of a leased privilege would require considerable expenses in the construction of roads or in otherwise rendering it available. For this reason there would be justice in allowing a right of renewal, upon compliance with all the conditions of the lease, but never for more than one year at a time. There might probably also arise cases in which several parties holding separate leases might have occasion to use a common improvement. The obvious way of meeting this contingency would be in a regulation by which each one should pay his share of these expenses in proportion to the benefits he might derive therefrom.

In other cases these common improvements might require an investment and a plan of management that could best be secured by a corporation charging tolls for its service, as in the case of turnpikes, railroads, navigable improvements, booms, and the like, the control of which should be in the hands of those most interested in their use.

(2.) *Conditions for Reservation of small Trees.*

As a prominent motive in the establishment of a system of forest management would be the maintenance of future supplies, the holders of privileges should be restrained from cuttings that should interfere with plans for this end. The selection of large trees, and the reservation of small ones, although far from being the most profitable way of managing a woodland, would be at first the more convenient one, and perhaps the only one that could be adopted at first, and in the terms of lease the occupant should be restrained from cutting any trees below a specified size. He should be required to protect the premises from injury so far as possible, and he should be answerable for all damages arising from his own acts or those of his employés, or from any neglect of duties required.

If assured of possession upon observance of conditions it would be for his interest to make the most of his opportunity. It would be to his interest to protect his right from all trespass, and in this he would have the law to sustain him. He would have no motive to overstock his market by cuttings beyond the demand, and he would have the benefit of the younger growth, as it came to a size for cutting, from year to year.

To insure the faithful performance of all engagements, all leased woodlands should be inspected at least once a year by competent and faithful agents, not at certain appointed times, but without previous notice, and on special occasions when necessary, and a report of these inspections should be made a matter of record.

(b.) *A Privilege of Sale by Auction.*—There would arise cases in which two or more persons might desire the same premises, and in these it might be necessary to award the privilege to the one who would pay most for it. The bonus thus obtained in the strife for possession might in some cases be more than the one paying it could reasonably afford to pay, and the experience in Canada (where this system has been tried many years) is not favorable. There are instances where it cannot well be avoided without a charge of favoritism, but, on the whole, it leads to more mischief than benefit. From the tables given upon a subsequent page it will be seen that in some years the premiums

obtained by auction have largely exceeded the ground-rents, but that they generally fall much below them, and sometimes disappear altogether. The disadvantages of the system are elsewhere more fully noticed in connection with our sketch of the history of timber regulations in Canada, and there can be no doubt but that parallel cases would arise in attempting to apply the rule in the United States.

(c.) *A Tariff, or Rate, to be paid for the Timber or other Forest Products taken from the Premises leased.*—This may be regulated as found by experience to be best calculated to insure a suitable return to the Treasury, and, together with the ground-rent, should at least be able to cover all the expenses of forest management, including the collection of the above revenues, and all the changes incident to the experimental stations presently to be described.

(d.) *Other Sources of Income.*—Besides these stated sources of income, there might be others arising from trespass, forfeitures, and penalties of various kinds. Under a well-organized and efficient system, these should gradually become less, from year to year, as the operation of the law became better understood, and the opportunities for its evasion less.

(e.) *Power of canceling Leases.*—In any mode of leasing timber lands that might be adopted (the title being retained by the government, and the younger growth reserved), there should evidently be power on the part of the agents in charge to cancel the privilege at any time, upon evidence of a violation of the conditions, and upon repeated disregard of these terms the parties should be disqualified from undertaking new leases.

(f.) *Agencies for Management.*—The system would require the appointment of agencies for the issuing of leases and for the collection of dues, and it would be desirable that the management should be under the same control as that for the general care of the Public Lands.

With respect to the cost and the revenues to be expected under this system of leasing lands, with the view of economizing and maintaining a timber supply, we may learn something from the experience of Canada. The ground-rent of Dominion Crown Lands, and of these lands in Ontario and Quebec, is \$2 per square mile annually. In New Brunswick it is \$8, and in all cases there is an additional charge for stumpage or timber dues, depending upon the amount of timber taken off, and constituting by far the greater portion of the timber revenues from these lands. The results may best be seen from the following tables:

4.—FINANCIAL EXPERIENCE OF TIMBER MANAGEMENT IN CANADA.

(a.) *Province of Ontario.*

| Years. | Square miles under License. | Details of Timber Revenue. | | | | Total Revenue. |
|-----------|-----------------------------|----------------------------|--------------|--------------|---------------|----------------|
| | | Ground-rent. | Bonus. | Timber dues. | Trespass, &c. | |
| 1867..... | 13, 465 | \$21, 821 24 | | \$79, 519 38 | \$3, 553 55 | \$104, 894 17 |
| 1868..... | 11, 584 | 17, 056 22 | \$14, 874 75 | 114, 341 81 | 13, 964 65 | 190, 237 66 |
| 1869..... | 12, 066 | 25, 686 41 | 33, 435 10 | 425, 773 35 | 23, 666 99 | 508, 561 85 |
| 1870..... | 12, 005 | 24, 883 08 | 9, 802 00 | 328, 258 49 | 17, 021 56 | 379, 965 13 |
| 1871..... | 12, 534½ | 26, 250 50 | 117, 900 00 | 413, 225 29 | 13, 506 47 | 570, 882 29 |
| 1872..... | 12, 538 | 26, 448 00 | 1, 668 50 | 615, 156 02 | 15, 883 39 | 659, 155 91 |
| 1873..... | 14, 545 | 34, 603 03 | 3, 019 00 | 511, 735 43 | 19, 367 87 | 568, 735 33 |
| 1874..... | 16, 259 | 33, 583 50 | 16 00 | 363, 926 19 | 19, 882 45 | 417, 408 14 |
| 1875..... | 17, 049 | 32, 670 27 | 412 00 | 338, 192 66 | 8, 176 68 | 379, 451 61 |
| 1876..... | 14, 981 | 32, 186 14 | 5, 606 08 | 316, 526 45 | 8, 079 39 | 362, 398 06 |
| 1877..... | 16, 132 | 34, 098 50 | 74, 993 81 | 292 222 72 | 8, 025 76 | 409, 340 79 |
| 1878..... | 16, 005 | 34, 433 00 | 14, 420 73 | 236, 836 61 | 7, 619 42 | 293, 309 76 |
| 1879..... | 16, 084 | 32, 055 50 | 14, 681 63 | 284, 330 22 | 10, 827 34 | 342, 894 69 |
| 1880..... | 15, 940 | 37, 238 42 | 9, 815 17 | 351, 718 03 | 14, 644 24 | 413, 415 86 |

From 1857 to 1866, inclusive, the amount of timber revenue received in Upper Canada was \$1,509,352.46, or an annual average of \$150,935.24 in each of the ten years. The largest amount in one year was \$197,093.73 (in 1863), and the least, \$94,921.15 (in 1857).

(b.) *Financial Experience of Timber Management in the Province of Quebec.*

| Years. | Square miles under License. | Details of Timber Revenue. | | | | | | Total Revenue. |
|----------------|-----------------------------|----------------------------|------------|-----------------|--------------|------------|------------|----------------|
| | | Ground-rent. | Bonus. | Transfer bonus. | Timber dues. | Trespass. | Interest. | |
| 1867-'68 | 17,997 $\frac{1}{2}$ | \$22,401 03 | \$3,928 50 | | \$165,381 77 | \$1,366 13 | \$2,038 52 | \$195,115 96 |
| 1868-'69 | 125,954 $\frac{1}{2}$ | 55,055 06 | 74,694 97 | | 198,977 82 | 882 34 | 1,940 93 | 331,751 12 |
| 1869-'70 | 32,486 | 64,089 20 | 24,102 37 | | 267,468 08 | 1,172 49 | 6,035 88 | 362,868 02 |
| 1870-'71 | 32,138 $\frac{1}{2}$ | 63,297 43 | 67,227 34 | | 272,833 12 | 1,949 61 | 1,173 07 | 406,480 57 |
| 1871-'72 | 40,056 | 86,783 01 | 60,877 81 | | 292,989 42 | 3,206 47 | 895 97 | 444,752 68 |
| 1872-'73 | 44,286 $\frac{1}{2}$ | 90,950 84 | 78,183 84 | | 346,361 27 | 1,711 71 | 1,474 96 | 518,682 62 |
| 1873-'74 | 48,064 | 97,220 37 | 31,386 93 | \$5,384 00 | 361,080 51 | 28,127 74 | 4,778 32 | 527,976 87 |
| 1874-'75 | 46,030 $\frac{1}{2}$ | 90,565 04 | 3,259 50 | 15,361 00 | 408,169 12 | 3,666 13 | 11,684 08 | 532,734 87 |
| 1875-'76 | 47,057 $\frac{1}{2}$ | 96,881 82 | 572 00 | 3,764 07 | 274,530 64 | 2,364 28 | 8,661 37 | 366,774 18 |
| 1876-'77 | 45,912 $\frac{1}{2}$ | 94,588 07 | | 16,658 82 | 269,685 24 | 4,792 07 | 5,894 65 | 391,618 85 |
| 1877-'78 | 42,484 | 85,385 12 | | 6,410 00 | 248,612 84 | 3,943 90 | 6,971 30 | 351,323 16 |
| 1878-'79 | 42,631 | 87,558 04 | 448 00 | 526 00 | 217,664 04 | 2,405 76 | 6,278 25 | 314,880 09 |
| 1879-'80 | | 96,157 86 | | 3,219 75 | 231,437 89 | | 12,065 94 | 342,881 44 |

¹ Thus reported for the first half of the fiscal years. The last half reported 9,865 $\frac{1}{2}$ square miles. The amount of timber revenue in Lower Canada from 1857 to 1866, inclusive, was \$1,444,740.50 or an annual average of \$144,474.05.

The system of management in the other Provinces of the Dominion is more recent, and is not strictly comparable with the foregoing. We give below the results of experience in New Brunswick:

(c.) *Receipts from Timber Licenses, &c., in the Province of New Brunswick.*

| Years. | Sale of timber Licenses. | Renewal of Licenses. | Stumpage (net amount). | Stumpage (trespass). | Total of preceding. |
|------------|--------------------------|----------------------|------------------------|----------------------|---------------------|
| 1874 | \$24,813 20 | | | \$305 32 | \$25,118 52 |
| 1875 | 6,736 25 | \$12,132 00 | \$33,674 50 | 259 90 | 52,803 65 |
| 1876 | 12,174 09 | 12,316 00 | 41,524 13 | | 69,014 22 |
| 1877 | 38,564 70 | 24 00 | 55,980 38 | | 94,569 08 |
| 1878 | 7,910 70 | 16,804 00 | 81,207 46 | | 105,922 16 |
| 1879 | 7,359 20 | 15,016 00 | 47,307 81 | | 69,683 01 |

5.—AGENCIES FOR MANAGEMENT OF TIMBER LANDS IN CANADA.

The Department of Crown Lands, in which is included the Division of Woods and Forests, has other duties in charge, including free grants and sales of land, surveys, patents, and roads, &c., and a system of agencies which in the reports for the year ending in 1880 were as follows:

(a.) *For Province of Ontario.*

At *Toronto*.—Besides the Commissioner, his Assistant, &c., there were four clerks in the Division of Woods and Forests, the latter with an aggregate salary of \$4,750 per annum.

At *Ottawa*.—An agent, his assistant, two clerks, a draughtsman, a messenger, a deputy slide-master and chief timber-counter, a timber-counter, and an assistant. Total salaries, \$6,135; besides \$2 a day to two men during the season of navigation. This office acts for the Provinces of Ontario and Quebec, as also for the Dominion Government, in the collec-

tion of slide-dues, and an additional salary was paid to the deputy slide master by the Department of Public Works.

At *Bellerive*.—An agent and clerk. Total salaries, \$1,940.

At *Quebec*.—A collector, an assistant, and a clerk. Total salaries, \$4,200. This office acts also for both Provinces. Besides the above, there were employed 21 wood-rangers, who were paid according to their services, the highest sum being \$1,616.70, and the total amount \$14,003.48 for the year. The further sum of \$1,269 was paid for inspections and \$17,608.43 for various disbursement, including seizure of rafts and other expenses.

(b.) *Province of Quebec.*

At *Quebec*.—Besides the Commissioner and his Assistant there were three clerks in the Division of Woods and Forests. The Crown Lands Department employed about forty local agents at some twenty-five different places, but as their duties were in some cases blended with the care of lands, &c., the expenses cannot be separately stated.

Such, in brief, is the result of forest management in the principal provinces of Canada so far as relates to the cutting of timbers upon the public lands. As to private lands, we have no source of information excepting that offered by the census; and upon these lands there is no pretext of control or direction in the clearing of lands any more than there is in its subsequent cultivation by the owners of farms in crops.

From this notice of the system of management of the woodlands of a neighboring country presenting conditions and interests strongly similar to our own, we may infer that the forests upon our public lands could be placed under regulations which might yield a revenue largely above the cost of administration, while they would give the authority and protection of law to those engaged in the lumber business, present strong motives for economical use instead of reckless waste, and afford in the mean time, without great expense, a reasonable prospect for future supplies.

6.—RECAPITULATION OF MEASURES RECOMMENDED FOR MANAGEMENT.

The method proposed may be concisely stated, as follows:

(1.) The withdrawal of the remaining timber lands of the country upon the public domain from future entry, gift, or sale, and their reservation for timber growth, excepting as local exceptions may be hereafter made for special reasons, to be ascertained and declared by law.

(2.) The annual sale of privileges for cutting timber upon the lands thus reserved, to be offered for competition to the highest bidder who can give adequate sureties for the performance of his engagement—a minimum price being first fixed from the returns of trustworthy agents of the government.

(3.) The reservation in all such sales of privilege of young timber of a specified size, and an obligation from the contractor to use due care in the prevention of injuries from fires or other causes, with the penalty of forfeiture of the privilege upon proof of willful neglect of these conditions.

(4.) The further payment of a rate to be fixed by law before the sale of privilege, and not liable to change during its continuance, for the timber, lumber, wood, or other products taken from the land included in the agreement.

(5.) The right of renewal for a period to be fixed by law, to those who

have fulfilled all the terms of their agreement, upon such equitable terms as may be ascertained by experience and fixed by law.

It is highly probable that in a course of years, when the timber regulations of the country had been tested by experience, and the methods of management were better understood, that a more direct management of the public timber lands would be introduced. We are fully convinced that the time has already come when this management might be immediately applied to portions of the public domain where, from peculiarly favorable circumstances, the native growth of timber has attracted the admiration of all travelers, and where waste and improvidence have been most conspicuously shown. We refer to—

7.—THE REDWOOD FORESTS OF CALIFORNIA AND OTHER HEAVILY-TIMBERED LANDS UPON THE PACIFIC COAST.

Although the management of these lands might be organized upon the same basis as that already proposed, we believe that the time has now come when important portions of the heavily-timbered lands still owned by the government upon the Pacific Coast, and especially those occupied by the native Redwood (*Sequoia sempervirens*), might be at once withdrawn from entry and permanently devoted to the production and maintenance of timber under the most approved forms of forest management.

These grand supplies of timber are now, and have been since the first settlement of the country, undergoing a rapid waste; and the lumbering operations in these forests have been carried on in the most reckless and improvident manner without yielding any revenue whatever to the government or any adequate benefit to the country. In short, they have been plundered and destroyed, with scarcely a semblance of restraint, until a time can be foreseen when they will be exhausted altogether, and we shall be left wholly destitute of these inestimably valuable resources which, under judicious management, might be maintained for a long period, affording, besides their due supply of timber to the country, a substantial income to the Treasury.

(a.) *Restricted Limits of the Native Redwood Region.*

It is well known that the natural limits of the Redwood are of relatively small extent, not reaching far inland, and being limited to the western slope of the Coast Range within the State of California; and that, although this species may be elsewhere propagated with some success, it never presents such vigor of growth and such wonderful development, as among the fogs and in the humid atmosphere of the Pacific Coast. It is there alone that it has reached the magnificent dimensions that have rendered it unrivalled among the forests of the world.

(b.) *The Fallacy of regarding the Supply as "inexhaustible."*

To the casual observer these supplies may appear inexhaustible, but there is nothing more fallacious or more dangerous than this imperfect conception of the limit of supply, in the midst of local abundance, and without allowance for the enormous demand that may exist, or the vast exhaustion of this supply that may be going on. Under this demand, coming in a large degree from Australia and from the Pacific coast of South America, as well as from our own country, the consumption has

increased rapidly from year to year, gathering energy from every new discovery in the arts that calls for these resources, and from every new opening in commerce or manufactures that seeks for these supplies.

It is true that considerable portions of these native forests have come to full maturity, and that the quality of timber thus matured will not in future improve nor its quantity increase. It is quite proper that such timber should be used when at its greatest value, and that the government and the country should derive the greatest benefit that is possible from this use. It is also true that there are still other portions that are now gaining in value, and that would continue to do so for many years to come, if suitable regulations were devised for their protection, and adequately enforced. There are also large areas from which the timber has been cut away that are now lying waste, in which every condition favorable to new plantation exists in full degree, as we have evidence in the growths but recently taken from them.

(c.) *Facility for Reproduction shown in the Redwood.*

The Redwood shows an unusual tendency to re-production, and when we consider the relatively small district within which all the conditions essential to its prosperity exist, and the remarkable results to which they may lead, we cannot but regard these localities as peculiarly valuable for timber culture, and this still more from the fact that from their broken surface they are worth little for any other use.

(d.) *Recommendations for Forest Management.*

We do not hesitate, therefore, to recommend, that not only the Redwood forests, but that also the land still belonging to the government from which these forests have been destroyed, should be set apart for forest culture and management, under such regulations as, upon careful inquiry, should be deemed proper and as experience might suggest. In whatever plan it might be thought proper to adopt, the main object of management should be to secure the greatest possible benefit to the country at the least expense and for the longest period of time.

(e.) *Different Modes of placing Forest Products in Market in Europe.*

In European countries that have well-matured and long-established plans of Forest Administration, we find two methods in use for placing their products in market. In France, this is done by selling at auction, at not less than a sum previously determined and at as high a price as can be obtained, certain quantities of standing timber, either upon given areas or as trees previously marked for cutting, their contents and value being first ascertained. The purchaser is bound to cut and remove this timber within a time and in a manner specified in the contract, under the observation of the agents of the forest service. He is responsible for the acts of his workmen during the time they are doing this work, and is not released from his obligations until, by a final inspection, it has been found that all his engagements have been performed. As the officers who make the previous estimates and the final reports are strictly forbidden from dealing in wood products, either directly or indirectly, or from having their relatives engaged in this trade, there is presumed to be no motive for unfairness in any of these transactions; and if any practices are discovered that can be traced to undue influ-

ences, the transaction becomes void and all guilty parties are severely punished.

In Germany, the cutting and preparation of wood and timber for the market is often done by the Forest Administration itself, and the products are delivered in market in the form in which they can be sold to best advantage or as needed for use.

With our present knowledge of forestry in the United States, and in the entire absence of experience as to the management of these interests by the Government, it cannot be known beforehand as to which of these methods would prove most satisfactory, or whether some other one might not prove better than either. In the hands of disinterested and upright agents either method might be adopted at the beginning with a reasonable prospect of success, and it is quite probable that the details would in a short time find their appropriate mode of execution under such modifications as experience might suggest.

(f.) Necessity of Preliminary Surveys and Inspection before definite Measures are adopted.

Before any definite measures could be adopted, it would be necessary to ascertain from surveys and inspection the extent, condition, and circumstances in which these forests are found actually to exist—not necessarily by section and township lines, which might be found of but secondary use—but with regard to their location, conveniences of access, the means available for the extraction of their timber, and other matters that should be known before any definite plans could be adopted for their care and management.

(g.) Extension of the proposed plan to other Pacific Forest Regions.

The plans above suggested with reference to the Redwood forests of California may be applied with equal reasons to other great bodies of timber still belonging to the Government upon the Pacific coast. Before definite adoption they should be preceded by special examination and surveys, and from the beginning they should be made the subject of full and careful record.

(h.) Qualifications of a Forest Agent.

A perfect plan of forest management, having in view sustained production through the longest period, implies a special qualification for the service, and both a theoretical and practical acquaintance with all matters affecting the growth and reproduction of woodlands. It requires the preparation of maps and plans and a programme for future management, the location of roads for the removal of products, the measurement of standing timber, the calculations of contents, and all scientific subjects that might arise in reference to a forest. So far as these duties are concerned, they can only be properly executed by a local officer specially educated for the business, or under his immediate direction. He should be attached to no routine that would prevent him from studying a subject presenting itself in a new aspect, or from appreciating and applying such modifications of a plan as new conditions might render necessary.

There is another class of duties that relate to the sale of timber and its delivery, protection from trespass, and other administrative details that can be performed by any person possessing vigilance, energy, in-

tegrity, and a good business talent. It might be proper to assign these general duties to two classes of agents under one central direction, but acting separately, each in matters that related to his own charge.

In case of such a division of duties, the one looking after the general welfare of a forest should decide when and where and how a cutting should be made, and should have the care of inspection to insure faithful observance of his conditions, but he should have no interest or motives in any way relating to the sales.

From an extended correspondence and personal acquaintance with European foresters, we are convinced that there are many persons educated in their schools of forestry who possess all of the qualifications implied in the class of duties first above enumerated, and should occasion arise for this employment it is highly probable that suitable and trustworthy persons could be found in every way qualified for this duty upon reasonable assurance of a permanence of position and adequate pay. To one having an enthusiasm for his profession, the opportunity would present motives worthy of the highest ambition and a wide field for scientific observation and honorable enterprise.

In the business department of such a forest service there should be no difficulty in finding those who would deserve confidence, and justify any expectations that might be raised in regard to their qualifications for the trust.

(i.) A serious source of Difficulty that is constantly growing worse.

We should not overlook one source of difficulty that would be encountered in setting apart timber lands for lease or management, viz: that resulting from vested rights already acquired along the borders of these woodlands, and especially at points most convenient for manufacture and export. In the absence of supervision, these locations have, in many instances, been used as the outlet of valuable timber cut upon the public lands in their rear. From the nature of the surface, which is often a steep declivity, the timber from the mountains must of necessity cross these lands already acquired by private owners, and the only legal remedy would be to obtain the right of way in manner already defined by law, or as may be hereafter provided.

The existence of this unfortunate condition of affairs is much to be regretted, and the longer it is allowed to continue the worse it will become. In a level country access can generally be obtained easily, and from various points, as the demands of trade may require; but among mountains, the outlet must be along the valleys and by lines of descent marked out by nature, although at a cost that may be enhanced by the claims of owners along the way. These claims can never be less than they are to-day, and they will certainly be advanced as their owners find them more valuable.

(j.) The Parties who would be Troubled by proper Regulations.

The only persons who could be injured by the adoption of this measure, would be those who are making profits unlawfully from the public domain, either by outright robbery, or under some pretext inconsistent with the public welfare, and alike unjust to the present, and injurious to the future.

(k.) The Replanting of Land from which the Redwood has been Destroyed.

As the sole object for the reservation of lands from which the redwood has already been cut away, would be to restore them to woodland

growth, care should be taken at the earliest practicable time to re-stock them with young trees, by seeding or otherwise, as might be found most convenient and effectual, and of giving them that protection that is needed for their growth. This being done upon a soil and under climatic conditions that have already proved highly favorable, we might reasonably hope that the enterprise would be rewarded by success.

(l.) *The Repurchase of Lands from private Owners in certain Cases.*

In cases where the title has already passed to private ownership, there would probably be found cases, both in existing timber lands and those that have been denuded, where it might be desirable to re-acquire the title in some manner just to the owners, in order to render the proposed forest-conservations continuous, and symmetrical in their boundaries, and convenient in location.

(m.) *The Aid that may be derived from Field-books of Land Surveys.*

The field-books of our land surveys, although primarily intended for the description of lines, would afford much assistance in the location of timber-reservations wherever these surveys have been made. It has been customary to note in these, the character of the surface, soil, and timber, and where these are determined along the lines that surround a given section, we have some indication as to the space within at the time the survey was made. Depredations may, however, have been since committed, or the region may have been overrun by destructive fires, that would render them an unsafe guide without other means for verifying the present conditions.

There are many cases in which maps might be constructed by the aid of these field-notes of first survey, that would show the original extent and importance of the native timber resources of a given region, and for historical use and comparisons such maps may hereafter be made.

(n.) *Suggestions with Reference to future Land Surveys.*

In future land surveys, it would result in benefits far above the cost, if specialists could be assigned to surveying parties, whose duty it should be to make notes of all geological formations in the vicinity of the lines run, keep barometrical records for the calculation of altitudes, and record all facts of interest relating to the timber, topography, soil, &c., that came under their observation. Had this information been provided for in former surveys, the government would have had at hand information that would have been of inestimable value upon points where it can now only be obtained by agents sent upon particular occasions, and at a considerable expense.

II.—EXPERIMENTAL STATIONS FOR FOREST CULTURE.

1.—GENERAL CONSIDERATIONS.

(a.) *Immense Range of Possibilities in the Growth of Forests.*

There is no kind of cultivation that involves a wider range of capabilities than that of forest trees, for we find them of one kind or another, where the aridity of the climate or the qualities of the soil do not for-

bid, growing in every latitude, from the equator to across the borders of the arctic zone, and at every elevation, from sea level to the "timber-line."

(b.) The Indications afforded in a Region formerly Wooded.

In undertaking this cultivation, it is of the first importance that we should understand, not only the limits of possible endurance, but especially those within which we may secure the most favorable growth. In a region that was covered with timber when its settlement began, we have generally an evidence of what might be secured by planting, in the remnants of the native growth still remaining, or in the plantations that may have been formed for ornamental purposes or other use.

(c.) The total Absence of Information of the Possibilities of Tree growth on the Prairies and the Plains.

It is not thus upon the prairies and the plains, where a beginning must at first be made in an experimental way, with no other guide than the probabilities that a given species, from a region where the conditions are known, will succeed under the new circumstances, because they appear to be similar. Yet these expectations will sometimes disappoint us, in a manner we scarcely know how, or why, at least not until we have carefully studied and compared them, and any enterprise undertaken without this knowledge may often end in failure, and consequently, in discouragement.

(d.) The Experience of other Regions cannot safely be applied.

It is found, for example, that the beech, the chestnut, or the sugar-maple can scarcely be made to grow in Western Iowa, although the conditions, so far as common observation shows, are very much like those in which these trees grow to perfection, and in fact never fail.

In the newly-settled prairies, and upon the plains west of the Mississippi River, where the want of timber is among the first to be felt, and where its cultivation is most likely to be first undertaken, there is the greatest need of this knowledge, because the capabilities of soil and climate are in the beginning unknown. The settlers are often young men without experience in timber-planting, and perhaps the knowledge they have upon the subject was acquired in a different climate, and under circumstances that cannot be found in their new abode. They are often men of slender means, and they cannot afford much expenditure in experiments of their own. If their first trials fail, as they are very apt to do when made without due intelligence, they become easily discouraged, and may too hastily conclude that no plantation can be made to prosper under the conditions in which they are placed.

(e.) The Advantages to be derived from Experiment in these Regions.

It is in such regions, where there is a strong probability that great advantages may be derived from the introduction of new and valuable species from other regions or countries, or from the practice of new methods of management, that the government might reasonably undertake, under the central direction of the Department of Agriculture, the formation of a system of experimental plantations with the best prospect of success.

(f.) *In the Selection of Locations for Stations, we should not wholly avoid Difficulties.*

In selecting the locations for these experimental stations, for determining the capabilities of soil and climate, we should by no means avoid a region that presents difficulties to be overcome, nor should they be attempted where there is an evident impossibility of success. It is along the borders of the region where settlement and cultivation have been found possible, with a probability of their permanence, that we can best apply these studies, with the view of determining the means best adapted for making cultivation remunerative, and investments for profit inviting. If we succeed there, we may reasonably hope to do so where the difficulties are less.

(g.) *Caution should be observed where there is much Uncertainty.*

Where much uncertainty exists at first, the beginning might be made with caution, and perhaps in some instances by way of subsidy to farmers, or by premiums for successful planting, until it was ascertained that a larger and more systematic undertaking should be permanently established.

(h.) *The local Influence of such Stations.*

In all cases, and at all times, such stations should be centers of influence upon the country around them, and it should be a matter of careful study to determine how this could best be done.

(i.) *The Questions to be determined in older Sections.*

In the older States, where much experience has already been gained concerning the capabilities of soil and climate for tree-culture, as well from observation of the native timber growth as from the experience of individuals, and where the difficulties to be overcome are comparatively slight, the inquiry that arises is not as to whether trees can be made to grow, but *what can be planted to best advantage.*

(j.) *Experiments may be made to great Advantage by the Agricultural Colleges.*

The local circumstances are there much more varied, and there is still need of much experience in forest-culture, but we have in every State an agricultural college, or a special department of agriculture in some older institution, which has for its especial object the promotion of rural and industrial interest, and there are almost without exception provided with sufficient opportunities for some degree of experimental plantation. We are well assured that the officers in charge of these institutions, would willingly co-operate in any system of observation that might be desired within the range of their opportunities, and at an expense never above the actual additional cost.

(k.) *The Object of these Stations is not to create a Supply.*

In devising a plan for a system of experimental plantations, we would therefore recommend that our principal efforts should be bestowed upon localities where there is the greatest present need, not with any view of actual production for the supply of wants, but mainly as stations for de-

termining possibilities and methods best worthy of recommendation, to those who might observe the operations or study the reports.

(1.) *The Lessons to be learned from Failures.*

There might be many failures to notice, and thereafter to avoid; for in trying many species in a new locality, where everything in the way of planting was unknown, there might be but a few of the many that would prove in any degree adapted to the new condition, and perhaps but one or two that were fully satisfied with their place. Yet, a knowledge of the negative list is a direct advantage, by preventing disappointment and loss. If it happened in the experience of an individual it might pass unnoticed, or perhaps be repeated by his neighbor, but if fully ascertained, and frankly acknowledged by official authority, it might hinder many unprofitable investments and disappointed hopes. We have knowledge of an eastern proprietor of lands in Nebraska, who, living in a region where the hemlock was of abundant and easy growth, conceived the idea that this evergreen would give ornament and value to his western estate, and caused many hundred young trees to be carefully packed and sent at great expense, for planting upon his prairie farm. It need not be added that not a single specimen survived the first summer.

This is but one instance of many that might be recorded in favor of the plan we propose for the establishment of a sufficient number of experimental stations for the careful and diligent study of climatic conditions, and the introduction of best methods for planting and management; not in places that offer the surest promise of success, but in regions where we may with reasonable prospect hope to derive the greatest benefit from such experiments. We will now separately consider some of the principles involved in the proposed undertaking:

20.—AN EXPERIMENTAL PRAIRIE STATION.

(a.) *Principles that should determine the Location.*

In establishing an experimental station in the midst of a prairie region remote from native timber of any kind, and under conditions entirely untried, a selection should be made which, as to soil and subsoil, would fairly represent the average of the region around, and if there were various grades of quality, they should, if possible, be all represented.

It is no longer a theory, but a fact demonstrated by long and numerous observations, that the presence of woodlands tends to equalize and moderate the vicissitudes of climate; but it is idle to expect this from a single grove of woodland upon an open prairie.

(b.) *Extent of Land that should be Included.*

There should be more land included in the station than that of a common farm, and as the location might be made without cost upon the public domain, a township of land might be set apart for this use. In the Territories, where the power of legislation on important matters is still vested in Congress, and as the property would be still held by the government, no provision would be needed with respect to taxation; but within a State it would be proper, before the final determination of locality, and especially if a site were purchased, to ask from its legislature a guarantee from taxation like that required in other lands and property of the United States acquired for forts, light-houses, and other

public uses. This should also include a provision for concurrent jurisdiction in the service of legal process, and an immunity against levy and sale of public property.

(c.) Temporary Occupation of portions for other Cultivation.

Although the reservation might include a township of land, it is presumed that not more than a section or two would be brought under cultivation within the first few years, and until needed for its proper uses other portions might be leased or used for cultivation, thus insuring the preparation of the soil necessary for beginning a plantation, and contributing in some degree to repay the expenses of the station. The boundaries of the tract should be plainly designated, and if in a grazing region, the portion under cultivation should be protected by a sufficient wire fence.

(d.) Convenience of Access.

The location should be chosen in a region not distant from one or more lines of railroad, either actually built or sure of early construction, as one of the objects would be to afford easy access for visitors as well as work worthy of their attention.

(e.) Roads; their secondary Uses in Case of Fires.

Care should be taken in the arrangement of plans, that sufficient roads be laid out around the border, and intersecting it at convenient intervals. These roads, besides their primary and principal uses, would afford lines of defense against the spread of prairie fires in the early years, and of forest fires in extremely dry seasons when the growth had become large enough to be endangered from this cause. It is stated elsewhere in this report, that open glades and vacant avenues through woodlands are esteemed in Europe the surest means for controlling the spread of fires, and the importance of this provision should not be overlooked in the beginning.

(f.) Plowed Belts as a Safeguard against Fires.

As a further safeguard against fires, especially in the early years, parallel furrows should be plowed around the parts under cultivation, and the space between should be carefully burned over under proper supervision, and when there is no wind. This operation can best be done a few days after the first heavy frost of autumn.

(g.) Buildings; Uniformity not Necessary.

The residence of the superintendent should be central, and the cottages of the workmen should be located with the view of affording some supervision of the premises. While due economy should be observed in all the buildings of the station, care should be taken that each in its way should be a model of elegance in its exterior design, and of convenience in its interior arrangement. Instead of uniformity of plan, they should afford as great a variety of style as might be consistent with their object, thus affording models for imitation to those who might find them suited to their wants.

Each dwelling should be surrounded by a sufficient plot of ground for an ample garden, and the inmates should be encouraged to undertake

ornamental plantations and rural ornament, under the advice of the superintendent, and with seeds and plants that should be furnished.

(h.) Thorough Preparation of the Soil essential.

In the midst of a prairie region, like Western Minnesota, and the central portions of Dakota, Nebraska, and Kansas, it is folly to attempt tree planting until the sod has been turned and thoroughly rotted, and the soil deeply mellowed by cultivation for one or two years previous. The time for first plowing is at the season when the vegetation of the grass and herbage is most vigorous, and before the ground becomes hardened by drought in the latter part of the summer. The length of the season in which sod may be plowed varies according to the amount of rainfall, and is much longer in some years than in others. The various conditions that affect this preliminary operation should be carefully observed.

(i.) Immediate Attention should be given to the Planting of Wind-breaks.

In an open prairie the first need in planting is protection against winds, and no time should be lost from the very beginning, in preparing the soil for the planting of shelter-belts of the trees known to be of most rapid growth, this quality being for this purpose of more consequence than the value of the timber when grown; but with the view of securing a more permanent growth of greater value, the latter might be planted among or within the former, with the ultimate intention of giving them full opportunity as found proper.

The width of these belts, the kinds of timber with which they are planted, and the size of the inclosed areas should be varied, with the view of ascertaining the best conditions, as well in the growth of the trees as in the protection they afford to the cultivated areas within. Until these areas could be properly planted with timber trees, they might be cultivated with farm crops.

(j.) The Objects of the experiment to be Determined.

The limit of season within which planting is possible or profitable; the relative advantages of spring and autumn for planting; the preference to be given to the sowing of seed in place or to transplanting from nurseries; the various methods of cultivation and management; the species that promise success and those that do not, and whatever else there may be within the limits of careful trial and observation, should come within the programme of experiment. A registry of daily doings, and a careful record of all operations, including failures as well as success, should be kept from the very beginning.

(k.) Meteorological Observations in the Air and Soil.

A system of meteorological observations, including as well those made in the soil as in the atmosphere, should be begun from the first. The former might include records of temperature at different depths, the evaporation and absorption of water, &c., and the latter the full series of records usually kept at a well-equipped meteorological station. As a woodland growth begins to appear there should be established a comparative station within its influence, with the view of studying the effect of this growth upon the local conditions, and the increase of this effect as the shade and protection increased.

(l.) *Field-culture in Connection with Forest Experiments.*

The fields under cultivation, while preparing the ground for tree planting, and in some instances for a longer period, would afford opportunities for testing new varieties of grain or different modes of fertilization or management, and for noticing the effect of timber belts upon the yield of crops adjacent.

(m.) *What should be accomplished by such a Station.*

In short, we would have the fields, the gardens, and the plantations generally the subject of careful experiment and observation, with the view of discovering and making known to the country such facts as might be found most worthy of attention. A station thus organized and conducted should be able to afford subjects of interest and profitable suggestion to every observing visitor, and could not fail of being of special benefit to the region in which it was located. It should make an annual report to the central office, and be always under its direction; but the resident superintendent should have discretionary powers to an extent sufficient to enable him to discharge his duties without embarrassment, and in a manner that should lead to most satisfactory results.

(n.) *Number and Distribution of these Stations.—Use of Military Reservations.*

Not less than two or three of such stations might be located upon the Plains within the belt suited for agricultural occupation, and it is quite probable that some one or more of the military reservations, already well supplied with buildings, and no longer important for their original purposes, might be reserved and set apart for these experiments in cultivation. The saving in first expenses by this would be very great, and indeed they might still, in a qualified degree, remain occupied for such purposes of storage and deposit without interference with the operations of a forest station, if this suited the convenience of the government. In some of the Western States measures have been proposed in their legislatures for the establishment of experiments in agriculture. They might be conveniently located upon adjacent grounds, or upon separate parcels of the same ground, as the proposed forest stations we have described, affording mutual aid to one another to the advantage of both.

(o.) *Practical Instruction in Methods that a Station might afford; Germs of future Schools of Forestry.*

Upon such a station there would be required a considerable amount of manual labor. It should be made an opportunity for the employment of young men who wished to acquire a practical knowledge of forest-tree planting, by working under competent direction, with the view of afterwards applying the skill thus acquired for the benefit of themselves and others. Although no plans are recommended in the beginning for any further instruction than what may be gained in actual hand-labor, it will be readily seen that we have in these stations, when they should have become fully organized, the germs of schools of forestry, which in time might become powerful agencies in disseminating correct ideas, and a thorough practical knowledge, upon the subject of tree-culture. With several of such stations in different regions of the United States, the student might be allowed to spend a portion of his

time at each, and thus be enabled to acquire a more enlarged and liberal view of his subject than if his training were all had in one locality. This idea is here stated without advice as to present adoption, but merely as a suggestion that in due time might deserve a careful consideration.

It would be obviously necessary that the superintendent of a station like one we have described, should be a man of thorough education, good business talent, zeal, energy, and integrity. We believe that such men could be found, who would willingly accept the appointment, from an honorable ambition to make the undertaking a success. As the enterprise would be wholly one of research in a field of knowledge but imperfectly explored, he should bring no preconceived ideas of routine, acquired in a field of labor or study altogether different from the one undertaken, but he should be a close observer of every condition or circumstance, competent to adapt his measures to meet the contingencies that would arise, and able to trace effects to causes, wherever this could be done. He should report annually to the central office, and in this be allowed the fullest liberty of presenting his views upon all subjects that might come within the range of his study or observation.

(p.) Wide Ranges of Climate and Conditions that must be Studied.

In view of the immense range of climate and conditions that occur within the United States, it would be quite impossible to realize the full advantages of experiments like those above described, unless several stations were established. Their location should not be fixed until after a careful study of the subject, and in this the remotest suspicion of private advantage, or of local or personal influences, should be avoided.

We would suggest as probably desirable, some point in Western Minnesota, or in Dakota; one in the interior of Nebraska, or of Kansas, or both; one in Southern California; one in Florida, and one in Texas. On a subsequent page, we will speak more fully of a proposed experimental station in the interest of the turpentine industries, which, being exceptional and special in its character, may be separately noticed.

3. THE EXPERIMENTAL STATIONS ON THE BORDERS OF THE ARID REGION ON THE PLAINS.

The conditions to be studied in these regions have, to some extent, been already noticed. We deem them altogether more important than any that might be found within the region once covered with native timber, and where forest trees may be easily grown in considerable variety, and to any desirable extent. In the three or four stations that we have suggested, extending from north to south across our territory, from British America to Mexico, we find indications of great natural capabilities for agricultural improvement in qualities of soil, embarrassed by serious difficulties in the climate. It is but a few years since this region was described by travelers as an inhospitable desert, incapable of settlement, and wholly worthless for any kind of cultivation. We now find agricultural improvements and much industrial wealth in regions once deemed hopelessly arid and irreclaimable; and it is confidently asserted that the limit of possible cultivation is now farther west than formerly. It is believed by many that the climate is now perceptibly improved, since the land has been brought under cultivation, and that the country is becoming less liable to drought as the settlements become older. These statements may in some cases be prompted by interest,

and in others, perhaps, the expression of confidence and hope; but there are enough of unquestionable facts to justify a serious inquiry into their reality, and enough of known possibilities to encourage experiments of the kind we have described.

It can no longer be doubted that the presence of groves of timber in a country tends to promote in a perceptible degree, a moderation of the extremes of temperature, and an increase of humidity in the atmosphere and in the soil. They favor the deposit of dews, and they afford obvious protection against winds, and shelter from the sun. It is not a matter of theory, but of fact, that throughout our prairie regions, and as far out upon the great plains as cultivation is possible, the welfare of our agricultural interests would be promoted by the cultivation of forest trees in suitable proportion and of proper kind, and this even without taking into account the material that they produce for the supply of wants that are constantly arising upon the farm. To encourage this planting should be among the duties of government, for it thereby but adopts a measure that tends to extend and multiply its own resources, in proportion to the wealth and welfare of its citizens.

The question of direct profit does not enter into these calculations, although we think it might be easily demonstrated, that were a proper quantity of our existing woodlands assigned to a forest administration, duly organized, not upon the plan of any one now existing in foreign countries, but upon principles consistent with the general plan and purposes of our government, the surplus revenues from our present timber supply now fully mature, would be more than sufficient to defray all the expenses incident to execution of the various measures we recommend.

4.—EXPERIMENTAL STATION IN SOUTHERN CALIFORNIA.

It has already been shown by successful trials that the soil and climate of Southern California are well adapted to the growth of semi-tropical fruit and forest trees, some of which are now cultivated to a considerable extent and with much profit. It is recommended that a station be established in this region for experimental cultivation, and with the view of determining the best modes of propagation and management and the advantages that may be derived from the introduction of new species. The Eucalypti, the Acacias, the Cork oak, and perhaps some of the Cinchonas, might thus be made the subject of more careful study than has yet been given, or can be undertaken by private enterprise.

Various species of the Cinchonas are now under successful cultivation in British India, in Java, and elsewhere, under conditions closely similar to those that exist in the region here under notice, and it would be easy to open a correspondence with the Australian colonies, and with other foreign countries, with the view of procuring seeds and plants of most of the species that offer any inducement for trial, with the view of determining their capabilities and the advantages that may be derived from their introduction.

5.—EXPERIMENT STATION IN FLORIDA.

(a.) *Very early Experiments in Cultivation of Live Oak.*

Within five years after the beginning of a constitutional form of government in the United States, the value of the Live Oak on the extreme

southern border had begun to be recognized as a material for naval construction. With the exception of small purchases of Live-Oak timber lands on the Georgia coast, nothing, however, was done towards the reservation of lands for this use until 1817, when an act was passed allowing lands having a growth of Live Oak and Cedar to be selected and reserved for naval use. In 1828 a small appropriation was made for the purchase of Oak lands on Santa Rosa Sound, and during two or three years a system of cultivation was undertaken, which consisted of grubbing out the roots of other trees, and clearing the ground around the young Live Oaks, so as to afford them a better chance for growth. Some trials were made at transplanting, but without success, perhaps from want of skill and experience, and the result of the experiment led to the conclusion that it was best to plant the seeds where the trees were to grow.¹

It will thus be seen that the earliest attempt in experimental forestry undertaken by the government was upon the southern coast, and that the object was in the interest of one of the most important branches of the public service.

(b.) *The Experiments proposed by Dr. Henry Perrine.*

An attempt at experimental cultivation originating in private enterprise, and having for its object the introduction of valuable tropical plants into Florida, as an investment for profit and public utility, may claim in this connection a particular notice.

Dr. Henry Perrine, a citizen of Illinois, received in 1827 an appointment as consul for the United States at Campeachy. His official district included the peninsula of Yucatan and State of Talasco, in Mexico, and during several years of official residence there, he became strongly impressed with the advantages that would result to the government that he served, from the introduction of useful tropical plants. He endeavored to secure the seeds and plants for transfer to Florida, but in this, for a time, he met with much difficulty, arising from the jealousy of ignorant and despotic officials and others having a controlling influence in the country. In the cholera epidemic that occurred during his residence, his professional skill, gratuitously bestowed, enabled him to render valuable services to the country, which won for him the cordial thanks of many persons of influence and a vote of thanks from the Mexican Congress. The favor thus gained, at length enabled him to succeed to a considerable extent, and he sent to a friend in Florida the Sisal plant, the cactus that supports the cochineal insect, and many other tropical species. He had an ambition to establish a plantation of these plants in a region where they could be propagated with certainty and profit, within the limits of the United States, and to establish a colony of poor but industrious families for their cultivation.

In February, 1832, he addressed a memorial to Congress in favor of the domestication of tropical plants in Southern Florida, which resulted in favorable reports,² and a bill, which, however, failed to become a law.

On the 29th of December, 1834, he again memorialized Congress from the city of Campeachy, renewing his application, and urging additional motives in support of his measure. In this memorial and in letters to the Secretary of the Treasury which he had previously written, he enumerates the numerous petty annoyances that he had experienced in the prosecution of his enterprise, through the jealousy of native officials,

¹ *Forestry Report*, 1877, p. 9, *et seq.*

² Doc. 198, Rep. 454, and bill H. R. 555, first session Twenty-second Congress.

and the prejudices which they had excited among the humbler classes of the community.¹

In the winter of 1837-'38 he came to Washington to lay his plans before Congress, and ask for the opportunity of putting them in execution. He placed upon exhibition, in a committee room used by the Committee on Agriculture, a large collection of the raw materials and manufactured products, and furnished for publication in connection with the reports made by committees many valuable facts, which are embodied in the two reports made upon this subject.²

(c.) *Act of Congress for Encouragement of Dr. Perrine's Experiments.*

He succeeded in procuring the passage of the following act:

AN ACT to encourage the introduction and promote the cultivation of tropical plants in the United States. Approved, July 7, 1838.

Whereas, in obedience to the Treasury circular of the 6th of September, 1827, Dr. Henry Perrine, late American consul at Campeachy, has distinguished himself by his persevering exertions to introduce tropical plants into the United States; and whereas he has demonstrated the existence of a tropical climate in Southern Florida, and has shown the consequent certainty of the immediate domestication of tropical plants in tropical Florida, and the great probability of their gradual acclimation throughout all our Southern and Southwestern States, especially of such profitable plants as propagate themselves on the poorest soils; and whereas, if the enterprise should be successful, it will render valuable our hitherto worthless soils by covering them with a dense population of small cultivators and family manufacturers, and will thus promote the peace, prosperity, and permanence of the Union: Therefore,

Be it enacted, &c., That a township of land is hereby granted to Dr. Henry Perrine and his associates, in the southern extremity of the peninsula of East Florida, to be located in one body of six miles square upon any portion of the public lands below twenty-six degrees of north latitude.

SEC. 2. *And be it further enacted,* That the said tract of land shall be located within two years from this date by said Henry Perrine, and shall be surveyed under his direction by the surveyor of Florida: *Provided,* That it shall not embrace any land

¹ These documents are reprinted in Report H. R. No. 564, second session Twenty-fifth Congress. It appears from these that he had succeeded in transferring over fifty species to Florida, including the mahogany and several other valuable species of forest trees.

² (1.) Report H. R. No. 564, second session Twenty-fifth Congress, to accompany bill No. 553, dated February 17, 1838, pp. 100. This reproduces a former report of the Committee on Agriculture, dated April 26, 1832, made during the first session of the Twenty-second Congress, and accompanying a bill not then acted upon.

(2.) Report Senate No. 300, second session Twenty-fifth Congress, pp. 142, and 24 outline engravings of tropical plants, dated March 12, 1838. Of these 5,000 extra copies were printed for the use of the Senate.

The memorialist enumerated among the exotics that might be successfully introduced and naturalized in the country, many of the beautiful and useful palms, the agaves, the shrubs for chocolate, coffee, and tea; the logwood, fustic, cochineal, and other dyes of Mexico, Guatemala, and Brazil; the cinnamon, pimento, ginger, and other spices of the East and West Indies; the mahogany, cedar, ebony, and other precious woods of all parts of the world; the bananas, anonas, mangoes, and other delicious fruits; the Peruvian bark, sarsaparilla, canela, and innumerable salutary medicines for the removal of disease. He stated that the extensive cultivation of a single species, the *Agave sisalana*, would alone furnish a profitable staple to the planters of the South, and a cheap material to the manufacturers of the North, which would supply many wants of our merchant vessels, of our Navy, and of our citizens in general. He represented that a tropical climate extends into Southern Florida, which opinion seemed to be well established by the meteorological observations that had then been made at Indian Key; that many valuable vegetables of the tropics do actually propagate themselves in the worst soils and situations in the sun and in the shade of every tropical region, where they arrive by accident or by design, and that for other profitable plants of the tropics which require human skill and care, moisture is the equivalent to manure; and that tropical cultivation essentially consists in *appropriate irrigation*, which in such a climate goes far to counterbalance the sterility of the soil.

having sufficient quantities of naval timber to be reserved to the United States, nor any sites for maritime ports or cities.

SEC. 3. *And be it further enacted*, That whenever any section of said tract shall be really occupied by a bona-fide settler, actually engaged in the propagation or cultivation of valuable tropical plants, and upon proof thereof being made to the Commissioner of the General Land Office, a patent shall issue to the said Henry Perrine and his associates.

SEC. 4. *And be it further enacted*, That every section of land in the tract aforesaid, which shall not be occupied by an actual settler positively engaged in the propagation or cultivation of useful tropical plants within eight years from the location of said tract, or when the adjacent territory shall be surveyed and offered for sale, shall be forfeited to the United States.

(d.) *Circular of Treasury Department to American Consuls in 1827.*

The circular referred to in the preamble of the above act was as follows:

No. 8.

Circular to a portion of the Consuls of the United States.

TREASURY DEPARTMENT,
September 6, 1827.

SIR: The President is desirous of causing to be introduced into the United States all such trees and plants from other countries, not heretofore known in the United States, as may give promise, under proper cultivation, of flourishing and becoming useful, as well as superior varieties of such as are already cultivated here. To this end, I have his directions to address myself to you, invoking your aid to give effect to the plan that he has in view. Forest trees useful for timber, grain of any description, fruit trees, vegetables for the table, esculent roots, and, in short, plants of whatever nature, whether useful as food for man or the domestic animals, or for purposes connected with manufactures or any of the useful arts, fall within the scope of the plan proposed. A specification of some of them to be had in the country where you reside, and believed to fall under one or other of the above heads, is given at the foot of this letter as samples merely, it not being intended to exclude others of which you may have knowledge, or be able, on inquiry, to obtain knowledge. With any that you may have it in your power to send, it will be desirable to send such notices of their cultivation and natural history as may be attainable in the country to which they are indigenous; and the following questions are amongst those that will indicate the particulars concerning which information may be sought:

1. The latitude and soil in which the plant most flourishes?
2. What are the seasons of its bloom and maturity, and what the term of its duration?
3. In what manner is it propagated—by roots, seeds, buds, grafts, layers, or how? and how cultivated? and are there any unusual circumstances attending its cultivation?
4. Is it affected by frost in countries where frost prevails?
5. The native or popular name of the plant, and (where known) its botanical name and character?
6. The elevation of the place of its growth above the level of the sea?
7. Is there, in the agricultural literature of the country, any special treatise or dissertation upon its culture? If so, let it be stated.
8. Is there any insect particularly habituated to it?
9. Lastly—its use, whether for food, medicine, or the arts?

In removing seeds or plants from remote places across the ocean, or otherwise, great care is often necessary to be observed in the manner of putting them up and conveying them. To aid your efforts in this respect, upon the present occasion, a paper of directions has been prepared, and is herewith transmitted.

The President will hope for your attention to the objects of this communication, as far as circumstances will allow; and it is not doubted but that your own public feelings will impart to your endeavors under it a zeal proportioned to the beneficial results to which this communication looks. It is proper to add that no expense can, at present, be authorized in relation to it. It is possible, however, that Congress may not be indisposed to provide a small fund for it. The seeds, plants, cuttings, or whatever other germinating substance you may transmit, must be addressed to the Treasury Department, and sent to the collector of the port to which the vessel conveying them is destined, or where she may arrive, accompanied by a letter of advice to the Department. The Secretary of the Navy has instructed the commanders of such of the

public vessels of the United States as may touch at your port, to lend you their assistance towards giving effect to the objects of this communication, as you will perceive by the copy of his instructions which is inclosed for your information. It is believed, also, that the masters of the merchant vessels of the United States will generally be willing—such is their well-known public spirit—to lend their gratuitous co-operation toward effecting the objects proposed.

I remain, respectfully, your most obedient servant,

RICHARD RUSH.

(e) *Directions for putting up and transmitting Seeds and Plants, accompanying the Letter of the Secretary of the Treasury of September 6, 1827.*

With a view to the transmission of seeds from distant countries, the first object of care is to obtain seeds that are fully ripe, and in a sound and healthy state. To this the strictest attention should be paid; otherwise all the care and trouble that may be bestowed on them will have been wasted on objects utterly worthless.

Those seeds that are not dry when gathered should be rendered so by exposure to the air, in the shade.

When dry the seeds should be put into paper bags. Common brown paper has been found to answer well for making such bags. But as the mode of manufacturing that paper varies in different countries, the precaution should be used, of putting a portion of the seeds in other kinds of paper. Those that most effectually exclude air and moisture are believed to be best for that purpose. It would be proper, also, to inclose some of the seeds in paper or cloth that has been steeped in melted beeswax. It has been recommended that seeds collected in a moist country or season be packed in charcoal.

After being put up according to any of these modes the seeds should be inclosed in a box, which should be covered with pitch to prevent them from damp, insects, or mice. During the voyage they should be kept in a cool, airy, and dry situation—not in the hold of the ship.

The oily seeds soonest lose their germinating faculty. They should be put in a box of sandy earth in the following manner: First, about two inches of earth at the bottom; into this the seeds should be placed at distances proportionate to their size; on these another layer of earth about an inch thick, and then another layer of seeds, and so on, with alternate layers of earth and seeds, until the box is filled within about a foot of the top, which space should be filled with sand, taking care that the earth and sand be well put in, that the seeds may not get out of place. The box should then be covered with a close network of cord well pitched, or with split hoops or lath well pitched, so as to admit the air without exposing the contents of the box to be disturbed by mice or accident. The seeds thus put up will germinate during their passage, and will be in a state to be planted immediately on their arrival.

Although some seeds with a hard shell, such as nuts, peaches, plums, &c., do not come up until a long time after they are sown, it would be proper, when the kernel is oily, to follow the method just pointed out, that they may not turn rancid on the passage. This precaution is also useful for the family of laurels (*Laurinæ*) and that of the myrtles (*Myrti*), especially when they have to cross the equatorial seas.

To guard against the casualties to which seeds in a germinating state may be exposed during a long voyage, and as another means of insuring the success of seeds of the kinds here recommended to be put into boxes with earth, it would be well also to inclose some of them (each seed separately) in a coat of beeswax, and afterwards pack them in a box covered with pitch.

In many cases it will be necessary to transmit roots. Where roots are to be transmitted, fibrous roots should be dealt with in the manner herein recommended for young plants. Bulbous and tuberous roots should be put into boxes, in the same manner as has already been recommended for oleaginous seeds, except that, instead of earth, dry sand, as free as possible from earthy particles, should be used. Some of the bulbous and tuberous roots, instead of being packed in sand, may be wrapped in paper and put in boxes covered with network or laths. Roots should not be put in the same box with seeds.

Where the seeds of plants cannot be successfully transmitted, they may be sown in boxes and sent in a vegetating state. Where more than one kind is sown in the same box they should be kept distinct by laths fastened in crosswise on a level with the ground in which they are sown; and when different sorts are required it will be necessary to make separate compartments in the box. In either case they should be properly marked and referred to in the descriptive notes which accompany them.

When plants cannot be propagated from seeds with a certainty of their possessing the same qualities which long culture or other causes may have given them, they may be sent in a growing state. For this purpose they should be taken up when young. Those, however, who are acquainted with their cultivation in the countries where

they grow will know at what age they may be safely and advantageously removed. They may be transplanted direct into the boxes in which they are to be conveyed; or, where that cannot be conveniently done, they may be taken up with a ball of earth about the roots, and the roots of each surrounded with wet moss carefully tied about it to keep the earth moist. They may afterwards be put into a box and each plant secured by laths fastened crosswise above the roots and the interstices between the roots filled with wet moss. The same methods may be observed with young, grafted, or budded fruit trees.

Where the time will permit, it is desirable that the roots of the plants be well established in the boxes in which they are transplanted. Herbaceous plants require only a short time for this; but for plants of a woody texture two or three months are sometimes necessary.

Boxes for the conveyance of plants or of seeds that are sown may be made about 2 feet broad, 2 feet deep, and 4 feet long, with small holes in the bottom covered with a shell or piece of tile, or other similar substance, for letting off any superfluous water. There should be a layer of wet moss of 2 or 3 inches deep at the bottom; or, if that cannot be had, some very rotten wood or decayed leaves; and upon that about 12 inches deep of fresh, loamy earth, into which the plants that are to be transplanted should be set. The surface of the earth should be covered with a thin layer of moss, cut small, which should be occasionally washed in fresh water during the voyage, both to keep the surface moist and to wash off moldiness or any saline particles that may be on it.

When the boxes are about to be put on board the ship, hoops of wood should be fastened to the sides in such a manner that, arching over the box, they may cover the highest of the plants; and over these should be stretched a network of pitched cord, so as to protect the plants from external injury and prevent the earth from being disturbed by mice or other vermin.

To each box should be fastened a canvas cover, made to go entirely over it, but so constructed as to be easily put on or off, as may be necessary to protect the plants from the salt water or winds, and sometimes from the sunshine. Strong handles should be fixed to the boxes, that they may be conveniently moved. During the voyage the plants should be kept in a light, airy situation, without which they will perish; they should not be exposed to severe winds nor to cold, nor, for a long time, to too hot a sunshine, nor to the spray of salt water. To prevent injury from the saline particles with which the air is oftentimes charged at sea (especially when the waves have white frothy curls upon them), and which on evaporation close up the pores of the plants and destroy them, it will be proper, when they have been exposed to them, to wash off the salt particles by sprinkling the leaves with fresh water.

The plants, and seeds that are sown, will occasionally require watering on the voyage, for which purpose rain-water is best. If, in any special case, particular instructions on this point or upon any other connected with the management of the plants during the voyage be necessary, they should be made known to those having charge of the plants. But, after all, much will depend upon the judicious care of those to whom the plants may be confided during the voyage.

Plants of the succulent kind, and particularly of the cactus family, should not be planted in earth, but in a mixture of dry sand, old lime, rubbish, and vegetable mold, in about equal parts, and should not be watered.

It may not be necessary in every case to observe all the precautions here recommended in regard to the putting up and transmission of seeds, but it is believed that there will be risk in departing from them, in proportion to the distance of the country from which the seeds are to be brought and to the difference of its latitude or of the latitudes through which they will pass on the voyage. It is not intended, however, by these instructions to exclude the adoption of any other modes of putting up and transmitting seeds and plants which are in use in any particular place and which have been found successful, especially if any more simple. And it is recommended that not only the aid of competent persons be accepted in procuring and putting up the seeds and plants, but that they be invited to offer any suggestions in regard to the treatment of the plants during the voyage and their cultivation and use afterwards.¹

(f.) *Commencement of Dr. Perrine's Experiments. His murder by Indians in the Seminole War.*

Dr. Perrine repaired to Florida with his family after obtaining this qualified approval of his plans, and it is understood that he commenced small plantations at Cape Florida and other points in the neighborhood, in which he introduced a variety of Central American plants, among which were three or four species of the agave, including that producing

¹Other accounts of the preparation of plants for transshipment by sea will be elsewhere given in these reports.

the sisal hemp, the maguey or pulque agave, the cochineal cactus, paper mulberry, date palm, &c., all of which did well, and some of which afterwards flourished and propagated of themselves.¹

Of these the sisal hemp was the one that appeared to be of most importance in an economical point of view, although further acquaintance might prove that some others possessed qualities that would render them objects worthy of careful attention. The gigantic plant out of which the sisal hemp is made, flourishes in arid, rocky land, especially delighting in a calcareous soil. The principal care in cultivation is in keeping down the weeds. The yield of cleaned hemp is about a ton to an acre annually after the plant has grown to a size that will admit of the cutting of the lower leaves. It brings in market nearly the same price as manila hemp, or about \$250 a ton.

In short, he established the important fact, that some of the most valuable and important of the fibrous plants of Central America and Yucatan, grow freely on the peninsula of Florida, and would probably become accustomed to locations further northward.

But his operations were blighted by the Indian war then existing in the region he had chosen for his establishment, and in this he lost his life.²

(g.) *Suggestions for Experimental Plantations in Florida.*

Since the death of Dr. Perrine some attempts have been made to encourage the planting of the Cork-oak, by the distribution of acorns, and of other foreign semi-tropical species, by the sending of seeds to persons who were expected to plant them and report the results. Something may have been attempted in the way of acclimatization by individuals, but the public gets no benefit from this experience, unless in an interested or accidental way if it succeeds, while others are left to repeat the attempt indefinitely if it fails.

There can be foreseen no reason why the Maritime pine and the Cork-oak should not grow as thriftily on the light, sandy soils of the southern border as they do in Southwestern France; and the success that has followed the attempts at the introduction of useful foreign species of trees and plants in this part of the United States, justifies the belief that a first-class experimental station of the kind we have mentioned in this region, would form a most advantageous feature in the plan we recommend.

¹ *Patent Office Report*, 1855, p. 242. *Tropical Fibers: Their Production and Economical Extraction*. By E. G. Squire, 1861, p. 16.

² Dr. Perrine was born in Connecticut, received a medical education, and lived some years at Princeton or at New Brunswick, N. J. He afterwards settled in Illinois, and was appointed from that State as consul at Campeachy, where he enjoyed opportunities for learning the native resources of that province, and of Yucatan and Sisal. Having commenced his experiments he was compelled to seek refuge from the Indian war, and took up his residence on Indian Key, a small island some 4 miles in circuit and 20 miles from the main shore.

On the night between August 6 and 7, 1840, the place was visited by a party of Spanish Indians, who had been driven to hostilities by the complications arising in the Seminole war, and a little after midnight the inhabitants were aroused by the war-whoop, the firing of guns, and the crash of breaking windows. Mrs. Perrine and her three children sought refuge through a trap-door leading into a cellar partly filled twice a day by the tide, and used for bathing, while the doctor went out upon a veranda and addressed the invaders in Spanish, telling them that he was a physician and one who had done them no harm. They went away for a short time, but returned about daylight, drove him to the cupola, where they murdered him, and then having plundered the house, they set it on fire. The family managed to escape by crawling through an opening, and seizing a boat partly laden with plunder, were finally rescued. The doctor is supposed to have been shot; and with the flames that consumed his dwelling and his remains, some of the seeds and plants he had brought to Florida, and all of his notes and manuscripts, perished.

6.—SPECIAL STATION FOR OBSERVATION AND EXPERIMENT UPON THE PRODUCTION AND MANUFACTURE OF TURPENTINE.

(a.) *The necessity of these Experiments.*

There is perhaps no American industry that is carried on more wastefully, or with a more reckless disregard for its maintenance, than the production of turpentine, as hitherto practiced in the Southern States. In working the pines for this purpose, "boxes" are cut into the tree near its foot, which are generally about six inches deep, with a capacity of three pints. From these boxes incisions are carried up from time to time, and the contents dipped out as they fill. There may be two or more of these deep cuttings in the same tree, and they would alone be sufficient to weaken its vitality and hasten its death. When the forest fires get into them they are sure to hasten the end.

Some years since an agent was sent from France for the purpose of learning what methods were in use for the production of turpentine in the United States that deserved their attention; he returned with the report that they had nothing to learn from the methods, and nothing to fear from competition, for the process in use *was little better than a clearing one.*

(b.) *The Great Economies to be learned from other Countries.*

In the *Landes*, and upon the *Dunes* in France, the Maritime pine (*Pinus pinaster*, the only species there used to much extent for this use) is cultivated with great success, as we elsewhere describe in detail in these reports. The incisions are shallow, and, although repeated every week and extended up a little higher at every cutting, they never exceed an inch in depth or cover more than half of the tree upon the lower part of its trunk. The flow of turpentine is guided down to a metallic lip driven into the trunk, and is caught in glazed earthen jars suspended beneath. After a few years the tree is allowed to rest; and the old incisions being grown over, the operation may be continued perhaps for fifty years, and, as there managed, to the constant improvement of the wood in quality, although not in amount.

There are other economies practiced in this industry that should be generally known throughout the pine region of the United States where turpentine is produced. There can be no reason to doubt but that great benefits would result from the establishment of an experimental station upon the public lands in some one of the States where this industry is important, not only for putting into practical operation the economies already known, but for making new researches tending to the discovery of principles having practical results worth applying and making known.

In the school of practical forest industries at Lissino, in Russia, the production and manufacture of resinous products receive attention, including every stage of the process, from the crude material to the refined products.

(c.) *Suggestions upon the Cultivation of the Maritime Pine.*

It is well worthy of inquiry as to whether the Maritime pine (*Pinus pinaster*), which has been found to thrive so successfully in Southwestern France, could not be cultivated equally well in the sandy and otherwise unproductive soils of the Southern States, from which the native pine timber has been cut away—proving in these situations more suit-

able for cultivation than the original growth. It is a species preferring a warm climate, and all attempts at its introduction upon the New England coast have failed. In France, it grows spontaneously, chiefly in the southwestern part, and on the Mediterranean from Nice to Toulon, and in Corsica. It has been introduced into the central, northwestern, and northern parts of France, and in England; but, for the production of turpentine, it has not been found to succeed beyond the limits of spontaneous growth.

It would properly come within the province of an experimental station devoted to the resinous industries, to determine the questions that might arise concerning the introduction and cultivation of this and other species, and all matters relating to their management, the results being reported for public information and use.

7.—THE SUPPLY OF TREE-SEEDS FOR EXPERIMENTAL CULTIVATION.

In Europe the supply of seeds for forest culture has grown into a regular and well established business, and those engaged in this trade have their agencies for collection and preparation fully organized and ready to meet any demand which their experience may lead them to expect. From these sources any desirable quantity of seeds of species within the range of their dealing could in any year be easily obtained. Among the exotic trees thus introduced, there might be some that would prove very successful for cultivation on a large scale in certain portions of our own country, and most of them would prove desirable acquisitions among those in quest of novelties or great variety in tree-growth. They should all be tested at the several stations for acclimatization that might be established, where there was any probability of success.

But tree seeds are often quite perishable and, as a general rule, they lose their vitality much sooner than the cereal and other farm grains. Some, in fact, should be planted as soon as they are ripe, and will scarcely bear transportation to a place distant from where they fell. They are also in many instances liable to lose their vitality from over drying, and in other cases they may be injured or spoiled from molding if not dried enough. Whenever successful keeping depends upon the maintenance of a certain degree of freshness, without too much or little drying, it is often difficult to keep seed through the winter following the season of their growth, and quite impossible to preserve their vitality for a longer period. In all cases it is desirable to follow as nearly as may be the indications of nature, in placing and covering the seed, and if the seed ripens early in the summer it should be planted invariably the same season, and as soon as may be after it is fully ripe.

We have as yet in this country no regularly established markets for tree seeds, because the need of such a trade has not hitherto been generally felt. A few enterprising nurserymen have ventured upon the experiment of making limited collections, but with these exceptions there are no means of knowing where and how fresh and reliable seeds of any given species might be obtained, except through the individual inquiries of the person desiring them. In several instances, where a foreign request has been received from official sources for information as to where the seeds of certain American trees could be procured, we have found it very difficult to find a person ready and willing to procure and forward the needed supply, at the proper time and in the proper manner.

As most forest trees bear their seeds more abundantly in some years than in others, and many of them none whatever for several years in

succession, a knowledge of the region where a given species abounds, affords no certain indication as to the possibility of a supply of seed in any given year. It would be necessary to know beforehand, from many correspondents, as to what species were in prospect of bearing in different sections of the country, and from these reports, made some time before the time of ripening, such localities might be selected as would most conveniently supply the demand for the year. The identity of species might in the mean time be established from specimens of the leaf, the blossom, and the unripe fruit, and arrangements made for securing for distribution such quantities as were needed when the time of full maturity arrived.

In the great majority of cases, a seed year in a woodland where any given tree is common, would very easily supply an almost unlimited demand, and the hand labor necessary for the collection might generally be engaged beforehand by the correspondent undertaking the task. Of course the services of all persons engaged in this work should be reasonably paid, in proportion to the time and labor bestowed.

It is believed that it would be an easy matter to organize a correspondence adequate to the procuring of all the information contemplated in this plan, and the centralization of these facts would enable the Forest Division to answer any inquiries that might be made from any quarter, as to the procuring of any particular kind of seed in any year, and afford the means of securing any quantity desired when the proper time arrived. This time is often of brief duration, for the ripened seeds may be speedily scattered by the winds, or be otherwise lost, unless under the observation of some person interested in securing them.

In the cultivation of farm crops there is commonly much certainty in the securing of seed in any given locality and to any extent within the possibility of growth, but with forest-tree seeds we are left wholly dependent upon nature for the production which can neither be foreseen long beforehand, nor much influenced, by any device of man. It therefore becomes necessary to watch for opportunities, and seek through a properly organized correspondence to anticipate, so far as may be, the localities where a given supply may be obtained, and the agencies through which it may be secured.

In this inquiry concerning forest-tree seeds, it is not expected that the Department having the subject in charge would undertake to procure supplies for sale, or in the slightest degree to interfere with the business of dealers in tree seeds. It would only supply itself for the use of its own stations, and for correspondents reporting the results of their planting, while it would be in condition to afford information to all who might make inquiries, whether with the design of collecting for the market or of purchasing for their own use.

Whenever a time should arrive when a market could be found for tree seeds in quantity, there is no reason to doubt but that persons would be found willing to supply it. From the exceptional difficulties that arise in this case, for the reasons above mentioned, we are led to suggest the measures that appear best calculated to secure the benefits from cultivation, without interference with any commercial interest, present or prospective, and wholly without preference or reward.

8.—THE FINAL OBJECTS OF EXPERIMENTAL CULTIVATION.

(a.) *Encouragement, rather than direct Compensation.*

In whatever measures there may be devised for the promotion of tree-planting, they should be framed with the view of *encouragement*, rather

than *direct compensation*. It would be only in extreme cases, where success was only to be obtained at great risk of failure, that a bonus in any degree approaching the cost of the experiment could be properly awarded for plantations upon private lands. As a general rule the cultivation of timber will never be undertaken by individuals, for the growth of wood as a material, where the cost much exceeds the market price, or at most the probable value as measured by the prices when it shall have grown to a size fit for use. It may be done for ornament in parks and private grounds, but these scarcely come within the province of Forestry, considered as an economic industry, and should be generally left to the enterprise of those who are to enjoy them.

(b.) *The Question of Profit must finally govern.*

Even in the case of ornamental planting, it soon becomes a practical question as to how far we can afford to protect in winter a tree that will scarcely thrive of itself in the open air without protection. In the case of choice fruit trees there may often be a motive; it may sometimes occur in cases where an exceptional beauty is displayed in the flowering season; but for all economical purposes, those only deserve the greatest care that return the greatest profit.

(c.) *Remarks of Conservator of Forests in South Australia.*

The Conservator of Forests in South Australia, Mr. John Ednie Brown, in the report for 1880-'81, the fifth since a Forest Board had been organized, and the third under his direction, in speaking of the nature of these investments, says:

In order that the Government and public may judge whether or not the administration of the Board, in the conservation and extension of our forests, is, commercially speaking, alone, without reference to any of the other advantages which are claimed for the operations of the Department, a success, and is conducing to the aggrandizement of the property of the State, I purpose, under this section, giving a brief sketch of the commercial nature of the improvements effected by the Board, together with an estimate of their value at the 30th June, 1881.

Forestry is a branch of our political economy which stands alone in the application of its administration to the requirements of the State financial matters. All moneys laid out by the State are looked upon as being expended upon either of two contingencies, namely, upon permanent improvements, or upon works of maintenance. In calculating the probable value of the State property, therefore, the amounts disbursed upon works of a *permanent* nature must form the basis for computation, and those classified as under the heading of *maintenance* are immaterial to the valuation.

In the construction or formation of the generality of works of a public character, the amounts first expended upon them constitute for all practical purposes their probable values for classification, and it is seldom that further expenditures of money in after years will sensibly enhance this. I refer here chiefly to such public works as roads, railways, jetties, harbors, and buildings. For instance, supposing that a sum of £10,000 has been expended in the formation of a thoroughly good line of road through a country, and that for a period of ten consecutive years £1,000 is laid out upon it annually in the way of repairs, so as to maintain its efficiency during that time. Then, although £20,000 has been expended upon the road altogether, the true value of that road does not exceed the £10,000 which was first incurred in its formation, because the £1,000 of annual expenditure has only been made to maintain its original condition, and consequently its original value.

In the formation of woodlands, however, the case has an entirely different aspect, and disappointing mistakes will occur in official matters if this is not thoroughly understood before the Board goes further with its work. I will therefore try briefly to explain this, and, for the more clearly grasping the matter, I will instance an imaginary case of 100 acres, which it is proposed to form into an inclosure for the culture of trees. To begin, we will suppose that the fencing, preparation of the ground, purchase or rearing of the plants, and the planting of these has cost a sum, in round numbers, of £500. Here, then, we have to ordinary observation, the plantation formed for the sum named.

This, however, does not represent its permanent valuation figure. The first year's disbursements upon the work is not sufficient, without further expenditure of moneys, to entitle it to be classed as one of permanent value. If the plantation be left to itself henceforth, with the view of allowing the trees to arrive at maturity, a decided loss will be the result. Following the planting of the trees will come a series of periodical prunings and thinnings, which are a necessary constituent of forest management before the plantation is considered out of the hands of the forester (here the builder), and in a position for self-regulation until its period of maturity and fitness for realization. Supposing these necessary works cost another £500; this will make the whole cost of forming the plantation a sum of £1,000, which will represent, for State classification, the amount expended upon it as a permanent improvement.

From these remarks, then, it will be seen that several years must elapse before the works undertaken by the Board can assume their representative permanent values.

(d.) Correspondence with Acclimatization Societies in other Countries.

With a system of Experimental Stations as above proposed, and with the co-operation, as might be hoped, of many of our Agricultural Colleges and other Institutions, and of individuals who might be willing to aid in these researches, there should be an active correspondence with Societies for Acclimatization throughout the world, at least to the extent relating to wood-producing plants, and the more important plants of economical value, and a mutual exchange of seeds and young trees.

Although a great deal in this way has been done by individual enterprise, and by local institutions in various parts of the country, there has never been that organized and thorough execution of this measure under the auspices of the Government, excepting as this may have been done in the importation and distribution of seeds and plants, formerly by the Patent Office and since 1862 by the Department of Agriculture. These have chiefly been through purchase, and not by exchanges; and we have had hitherto nothing in the way of associated effort comparable with the Acclimatization Societies of many foreign countries. It might be proper to limit the operation of such exchanges to seeds and plants, or to such new silk-producing insects or other useful species as depend upon the foliage of trees for their support.

It should be a leading object, so far as might be, to aid by correspondence the efforts of individuals, or of institutions, who were disposed to undertake these importations at their own expense; thus giving to the country the benefit of every useful product that it can be made to produce. It should be required as an indispensable condition of this assistance that reports should be made of the result of the experiment, whether successful or otherwise, as a contribution to our knowledge upon the subject. If successful, it might be made generally known for the common good; if a failure under every condition that could be applied, this should be known as a warning against the future disappointment that might follow a like enterprise under like conditions.

(e.) Encouragement of Tree-planting among Farmers.

This measure deserves a most prominent place in any plan that may be adopted under the auspices of the Department of Agriculture in the interest of Forestry. The necessity of planting is suggested at the very beginning of settlement upon the prairies and the plains, by the absence of materials for buildings and structures of every kind. It is gradually coming to be felt in other regions, where timber supplies, once accessible, are now becoming scarce and high-priced, and it has a tendency to increase in sections where this want has not heretofore been felt, as market prices may invite to investment in this form of cultivation, with expect-

ation of profits. We may consider some of the ways by which this may be encouraged by the government:

1. *By publications* issued by the Department of Agriculture. In the preparation of these it should be remembered that while some subjects in Forestry are of general interest, there are many others that have a more special and local importance. While the former might be included in the general reports made to Congress, it would be desirable that the latter should be carefully prepared with reference to their particular object, and that they should be chiefly distributed in the region to which they applied. Among these special objects of interest we might specify the following:

The plantation and management best adapted to the arid regions within the limits of possible cultivation.

The cultivation best applicable in connection with irrigation.

The resinous industries of the pine regions of the South.

The semi-tropical vegetation of Florida, and of the other Gulf States.

The introduction and growth of the Eucalyptus and other valuable foreign species in Southern California, or elsewhere, as found particularly successful.

The plantation of dunes and sand-wastes, and the improvement of barren lands generally by cultivation.

2. *The promotion of discussions upon questions of Forestry* by means of conventions and associated effort, affording opportunities for the comparison of experience and the statement of methods.

There might be found difficulties in the way of organizing these meetings and associations independently at first, but until such time as this could be done with success, it would be well, as far as possible, to induce the existing agricultural and horticultural societies of the country, and such as may hereafter be formed, to establish within their own organizations a section of Forestry, or at least to appoint a committee having special charge of this interest. In Minnesota a State Forestry Association has already been formed, and in Iowa, Kansas, Massachusetts, Pennsylvania, and other States efficient committees for this purpose have been appointed and small separate publications upon silviculture have been issued.

A direct interest is given to these associated efforts by appointing meetings for discussion and the reading of papers in localities directly concerned in their practical application. In the case of Forestry these might be made still further useful by visits to nurseries and forest plantations where unusual difficulties had been overcome or notable success obtained.

Such meetings in the interest of agriculture are now held by State boards of agriculture, and the custom might be properly recommended to the officers of State universities and of agricultural colleges. The plan of associated effort here suggested readily admits of subdivision into districts, in which the special wants and opportunities of the region would properly receive most attention.

As the system grew in importance these auxiliary agencies of influence and information would naturally separate, and might ultimately form a distinct series of associations, having national, State, and local organizations, united by a common interest and operating for a common end.¹

3. *Direct instruction by persons specially appointed.*—Among the agencies of popular instruction adopted in some countries of Europe, more

¹This was written before the convention at Cincinnati in April 1882, and the organization of an "American Forestry Congress" that resulted therefrom.

especially in Germany, France, and Switzerland, is one that deserves mention in this connection, although the time may not have come for its application in our country. It consists in the employment of thoroughly-qualified persons to deliver lectures and hold "conferences" at times previously appointed and in places most convenient for the attendance of those whom it is expected most to benefit. The subject is generally one of very special interest in the localities visited, and those conducting these meetings are expected to answer as far as may be any inquiries that may arise. Among the subjects thus presented the following may be mentioned:

Milk and the dairy interests.

Wine and vine culture, with various questions arising in this connection.

Beet-sugar and the cultivation of beets.

4. *By the distribution of seeds and plants*, in this carefully discriminating with respect to the adaptation of the soil and climate to the objects sent. It would be proper to request the persons receiving them to report their success or failure, and any observations of interest that might occur concerning them.

III.—METEOROLOGICAL OBSERVATIONS WITH THE VIEW OF DETERMINING THE INFLUENCE OF FORESTS UPON CLIMATE.

(a.) *General character of these observations.*

In recent years, observations have been established with the view of determining the influence that woodlands exert upon the atmosphere within and near them, their effect upon the rainfall, the amount of water in streams, and the protection they afford to agriculture generally by their equalizing influences upon the temperature and the humidity of the country, and by their shelter and shade.

These observations are made at the expense of the government, and are generally placed under the direction of some professor in a school of forestry who has given particular attention to the subject of climatology, for central direction and the preparation and publication of the results. They generally embrace the following observations, which are made in each place at two stations, one out in the open fields and the other fully within the influences and under the shelter of the woods:

1. Temperature of the open air at about five feet above the surface. The extremes of temperature are often determined by self-registering thermometers.

2. Temperature of the soil at different depths below the surface.

3. Humidity, as shown by the psychrometer.

4. Depth of rain and melted snow.

5. Evaporation from a free water surface, and from soils of different kinds, either free from covering or having a growth of mosses and herbage on a thin cover of litter.

6. Percolation of water through soils of different kinds.

7. Direction and force of the winds.

8. Amount of ozone in the atmosphere.

9. General observations of occasional or periodical phenomena, such as unusual storms, destructive frosts, &c., the dates of appearance and disappearance of birds and insects, the time of putting forth and of the fall of leaves, first appearance of flowers, ripening of fruits, and beginning of harvest. A record is made of fogs, dews, unseasonable frosts, and the like, and, in short, of whatever tends to show the progress of the seasons or that enables us to compare one year with another, or to

judge as to the climatic conditions of different regions and their adaptation to particular kinds of cultivation.

The station in the woods has often an elevated platform for ascertaining the temperature, humidity, &c., at the level of the tree-tops, and thermometers are sometimes placed within the trees for observing the changes of temperature that take place.

These systems of observations are equally in the interest of agriculture and of forestry, and tend to show their mutual relation and dependence so far as relates to climatic influences and meteorological effects.

(b.) Invitation for co-operation with Foreign Governments.

As an evidence that this subject is receiving much attention in Europe, an official letter was addressed about a year since by the chairman of a committee of an international meteorological congress to the Chief of the Signal Service in the War Department, and referred by him to the Department of Agriculture for attention. It invited correspondence and co-operation with the view of establishing uniform and comparable observations in different countries for the general advancement of knowledge upon this subject.

We have since had a personal interview with this gentleman at Vienna, and are more fully informed as to the objects of the proposed inquiries.

(c.) Notice of the origin and early proceedings in reference to Agricultural and Forestal Meteorology.

In 1873 a series of resolutions was adopted at an international congress of agriculturists and foresters at Vienna, recognizing the importance of meteorological observations in the interest of agriculture.

In 1877 this subject was discussed at an international meteorological congress held in Rome, and at another session held at that place in April, 1879. Upon the question as to the manner in which it could best contribute to the development of agricultural and forestal meteorology the following resolutions were adopted:

In order to contribute as much as possible to the advancement of meteorology in the interest of agriculture and forestry, the following researches should be undertaken, viz.:

1st. To determine the influence that the meteorological elements exert upon vegetation:

2d. To ascertain, in like manner, what effect vegetation has upon these meteorological conditions; and,

3d. As to the prognostications which may be made for the information of farmers.

This congress, deeming these questions too important to be considered at present in detail, advises that its international committee shall call a special meeting, at a time not later than the coming spring, to deliberate upon this question.

(d.) The appointment of a Conference at Vienna.

Mr. H. Wild, of St. Petersburg, the president of this congress, and Mr. R. Scott, its secretary, in pursuance of these instructions, in December, 1879, suggested Vienna as a proper place for this special meeting, and the preliminaries being arranged, and a time appointed for the following September, the following programme was issued:

The task imposed upon the Meteorological and Agricultural conference is not so much to find new methods of observation in this special line of meteorology as to determine the place that this should have in the existing systems and the best manner of organizing them for participation in it.

(e.) The points proposed for consideration.

For this reason the conference shall concentrate its attention upon the following points:

1. What reciprocal relations exist between meteorological conditions and vegetation, both as to those already proved and accepted, and as to such as science may enable us to ascertain with certainty, as well as theoretically?

2. To the determination of what meteorological elements, therefore, should we give a special study, on account of their particular influence upon vegetation?

3. In what number, and in what manner, may stations for observation, embracing the desired records, be best established without prejudice to the objects for which the investigations for general meteorological observations were founded, within the sphere of inquiry mentioned in the second of the above questions?

4. Would it, or would it not, be useful to fix and establish, by general institutions, the observations that should be made with reference to phaneological¹ and other records?

5. Are the central establishments already in actual existence in condition to publish, with any chance of success, any prognostications of the weather that could be turned to the profit of agriculture; and if so, in what way can this service be most effectually organized?

As a preparation for these labors, various summaries were arranged by persons who had given especial study to these subjects, viz.: Upon questions 1 and 2, by Dr. Joseph R. Lenz von Liburneau, of the Austrian forest service; upon 1, 2, 3, and 5, by Dr. Jules Hahn; upon the general series, by the meteorological society of London², and upon 2, by Professor Cantoni.

The subject had, since the congress at Rome, been also under study by Dr. Lorenz, of Vienna; Professor Bruhns, of Leipsic; Father F. Denza, of Rome; and Dr. Hellmann, of Berlin.

(f.) Proceedings at the Vienna Conference in 1880.

The conference was attended by twenty-four delegates, representing Germany, France, Belgium, Italy, Switzerland, Denmark, Hungary, and Austria.

It was decided to appoint two subcommittees: the first to consider questions 1, 2, 3, and 4, in their relations one to another, while the other was to limit itself to the study of the fifth. These subjects, having been discussed in subcommittees, were referred to the general conference, and, after some modifications, were adopted in the following form:

RESOLUTIONS.

A.—UPON THE FIRST QUESTION.

1. Vegetation is influenced in an essential manner by the meteorological conditions, as follows:

(a.) By the temperature of the atmosphere and of the soil.

(b.) By the duration and intensity of the solar light.

(c.) By humidity in every form; and, therefore, the absolute and relative moisture of the air, rains, and other forms of condensation, such as fogs, dews, frosts, &c., have a notable effect.

(d.) By currents of air.

The changes of atmospheric pressure and of ozone do not cause a perceptible effect upon the progress of vegetation.

2. On the other hand, the meteorological conditions that seem to be subject to the influences of vegetation are as follows:

Vegetation in masses (meadows, cultivated fields, forests, marshes, and the like)

¹The term "Phaneological," not, as yet, generally found in English lexicons, is adopted as applied to all records of casual or periodical events that are not a subject of instrumental observation, such as the appearance and fall of leaves, the blossoming of plants, and ripening of their fruits; the arrival and departure of migratory birds, the appearance of insects, and especially of such as tend to injure in agriculture or forestry, and other miscellaneous events.

²This note is given on a subsequent page.

imply within the space where they are found the presence of those conditions of temperature and humidity in the air, and probably in rains, that are proper for their existence, and they may in these exercise an influence upon the climate in their vicinity in so far as relates to temperature, moisture, rains, springs of water, &c.

B.—UPON THE SECOND QUESTION.

3. In general, it appears to be of great importance that researches should be undertaken under authority, and upon a national basis, at as great a number of places as possible, in reference to all the meteorological elements recognized as important concerning the cultivation undertaken upon different soils and in different localities; and, furthermore, that the results of these observations should be compared with the results of harvests every year, with the view of ascertaining, if possible, the influence that climate is able to have upon the various forms of vegetation.

The means afforded by the general system of meteorological observations are not sufficient to allow us to form a judgment upon the various kinds of cultivation, or the circumstances of particular places.

4. The conference adopts the views expressed by Director Hahn in the following proposition:

That it is proper to recommend to governments and to agricultural societies to see to it that these stations are distributed in such a manner as to enable us to take account of the climatological conditions upon which cultivation in different forms depends, as well as with respect to the limits of the regions that are most congenial to them and the boundaries that they should not pass.

As regards the meteorological elements taken separately, the discussion of the second question gave rise to the following results:

(1.) *As to Temperature.*

5. It is recommended that comparative experiments be made as to the best manner of placing and sheltering thermometers.

(A diagram showing the different kinds of shelter for thermometers in use in different countries was to be finally sent to the members of the conference.)

6. As to the observations that should be made daily upon the temperature, the conference advises that when only two can be taken it is best that they should be in morning and evening, and that, besides these, the maximum and minimum temperatures should be recorded.

7. As to observations upon the solar action, an actinometer upon which entire reliance can be placed is unknown, and observations ought to be made at first only upon the force and intensity of the sun's action at particular instants, and this only at stations of the first rank. It is recommended to scientific institutions that measures be devised for the construction of an actinometer by means of which we may measure the totals of temperature furnished by the sun's heat.

8. The temperature of the soil should be observed at least at four different depths from the surface to a meter below it, upon soils of different kinds, and under various cultivation; and this is within the sphere of operation of all agricultural and forestal experiment stations, whether special or for other objects.

9. As to the occurrence of frosts, this should equally be made the subject of particular observations, and some studies still remain to be made as to the best method of securing these observations, in practical point of view, by employing minimum thermometers, and in avoiding their exposure to other influences than those of the open air.

10. It seems to be proper that experiment stations of the first order should undertake researches in order to ascertain the relations that exist between radiation in a clear sky and the humidity of the atmosphere.

(2.) *As to Light.*

11. Methods of photometric observations should be devised, especially with reference to the chemical effect of light, to be perfected for use in special scientific instruments, with a view of affording a good photo-chemical apparatus.

(3.) *As to Hygrometers.*

[Moisture in all its forms.]

12. Observations concerning the relative humidity of the air should be made by means of August's psychrometer and the hair-hygrometer, and these, if possible, three times a day, one of which times should be the early hours of the afternoon.

As to the apparatus to be generally used, the conference recommends that comparative observations should be made with both the complicated volume hydrometer of Schwackhöfer, of Vienna, and the simpler form by Edlmann, of Munich, so as to ascertain which of these two forms of apparatus should be definitely recommended to use in stations of the first rank.

As to stations of lower order, they should be limited to the use of August's psychrometers and to the hair-hygrometers.

13. The conference is of the opinion, as a matter of great importance, that researches should be made concerning evaporation, since there does not now exist any instrument for this purpose that the conference can recommend for general use. It is therefore desirable that an apparatus should be invented convenient for these observations, and especially one by means of which we might determine not only the evaporation from a free water surface, but also that from soils under cultivation. But in waiting for this the observations heretofore undertaken should not be suspended, but, on the contrary, continued with such means as are already known and in use, particularly those based upon measurement by weight, as also with the evaprometer of Piche, as modified by Cantoni.

14. As to observations upon condensation, all the forms under which it occurs should be inclosed in our studies.

15. The conference advises that it is in the interest of agricultural and forest meteorology observations should be made upon the dews, and, in the absence of an instrument perfectly adapted to this purpose, we should note in as exact a manner as may be their occurrence, and seek to discover a convenient means for measuring its amount. As to observations upon fogs, it would be best to adhere to the rules adopted by the general meteorological congress of 1873.

16. Observations upon the rainfall should be made in respect to agricultural meteorology in the matter indicated by the general meteorological congress.

It is of great importance that these stations should be as numerous as possible, at which only observations upon storms and rain should be made.

17. For measuring the snow, it is important that no apparatus should be used from which the snow, after falling, can be carried out by the winds.

18. The range of observations to be made in agricultural meteorology ought also to embrace those showing the absorption and evaporation of the water contained in the soil, and for this purpose we ought always to avoid the use of lysimeters.

The means employed for this purpose by Professor Ebermayer, of Bavaria, are made the subject of description in an article appended to this report.¹

(4.) *As to Winds.*

19. Observations made upon the direction and force of the wind should form a part of agricultural meteorology in the same manner as in general course of meteorological observations.

(5.) *The general Study of Influence.*

20. It is thought desirable, in order that we may arrive at a knowledge of the climatological peculiarities that distinguish the different groups of vegetation from one another, such as forests, meadows, marshes, or moors, and in what manner they differ from naked soil, that new experiment stations should be established, such as those first organized in Bavaria and afterwards in other German states, in Switzerland, and to some extent in France.

As regards the stations of this kind placed within a forest, it would be well to add observations upon the quantity of water that flows down the trunks of trees.

21. It would be convenient, in order to determine the climatic influences which great

¹A few months since, we were shown this apparatus by Dr. Ebermayer, as he has it operation in the gardens adjoining the university in Munich. A pit is dug about ten feet long and six feet and a half deep, with vertical walls of masonry, a stone floor, and steps for descending at one end. The space between the walls is about five feet wide, and the pit is closed by a sliding deck. Outside of the walls of the pit above-described two other excavations are made on each side, and one at the end opposite the stairs. These are each two meters square, and about half that in depth, with the bottoms conical, and connecting with pipes that lead to receiving vessels on the floor of the pit. These excavations are filled level full with soils of different kinds, and the rain that falls upon their surface percolates more or less readily through them, and is measured from time to time. His thermometers slide down to different depths, and are drawn up only at the time of observation.

The professor had no convenient place for comparative observations in a woodland near Munich, and in this respect his station was but half equipped, although in every other way it was a model of its kind, and perfectly answering the purposes of instruction for which it was specially designed.

groups of vegetation, such as forests, for example, exert to a greater or less distance upon the country around them, that we should establish radiating stations. These would promise greater success in proportion as they are more inland, and consequently in central Europe, in such countries as Germany, Austria, and Hungary, they are particularly desirable. In new experiment stations, and especially in those radiating from a center of influence, it would be of great importance to extend our observations upon the temperature and humidity, so as to determine their conditions immediately above the tree-tops.

C.—UPON THE THIRD QUESTION.

This conference considers the points above enumerated as an incumbent duty in agricultural meteorology, and expresses the advice that it is very desirable, at least in states of the first order, and where no system of observations applicable to this object already exists, that central organizations of a special character should be established for this branch of meteorology, trusting that this branch of the service will contribute to the completion and perfecting of the methods still very insufficient for the researches already in use, creating at the same time many stations of a secondary grade, and taking the first steps toward their establishment. It is hoped that the aid of individuals and corporations for the formation of the like stations under their control and observation, and that they may gather from every source, and turn to the best advantage, the information thus obtained.

These special stations ought always to act under the advice of the central meteorological director in whatever relates to an important point, such as a particular mode of observation or of publication of results.

D.—UPON THE FOURTH QUESTION.

23. The conference decides that it would be advisable to charge a special committee composed of three members, with the duty of preparing a plan of general instructions concerning phænological observations, founded upon an examination and comparison of the instructions already existing in most countries. This object should be managed by correspondence, and in all cases it should take care that observations be not extended to include too great a number of plans, taking into consideration as of first importance the cereal and leguminous crops; next the principal kinds of forest and fruit trees; and, lastly, other kinds of plants and what relates to animal life.

E.—UPON THE FIFTH QUESTION.

24. This conference is of the opinion that meteorological institutes cannot further devote themselves to the exigencies of practical life in matters relating to prognostication of the weather, notwithstanding the difficulties that attend this treatment of the subject.

25. This conference recommends to those to whom the direction of meteorological observations may be confined that they would do a service by preparing a popular work indicating the general principles upon which the prognostication of the weather should be made, so as to afford a guide to agriculturists.

(g.) *Reply to inquiries by the Meteorological Society of London.*¹

This reply, alluded to in the above proceedings, was as follows:

* * * 1st. Healthy vegetation depends on due proportion of warmth, moisture, and light. In overcast and moist summers there is luxuriant leafage and little flower; in sunny and dry summers leafage is moderate and flowering great—possibly no great amount of fruit, as the plants may be too much dried by it. These main points are much modified by circumstances that affect the ground temperature, and these ground temperatures are of great importance, as through them the flow of the sap may be retarded, or may be active in one part of the plant whilst it is exactly the reverse in the other, *i. e.*, above or below ground, as the case may be. The importance of this consideration is practically acknowledged by vine-growers; and more information on and practical working of the subject would be of great service in the management of crops. The effect of a mild, overcast, and moist summer and autumn, or the reverse, upon the ripening of the wood of that year and the fruit and leaf-buds for the succeeding year is probably considerable, and more information on this subject is desirable, as also the effect on agricultural seeds, especially with regard to the cereal

¹Referred to on page 44.

crops, as exemplified in the bread made from corn harvested in bad seasons; notably, in 1839, drawing out into long, sticky strings.

With respect to the allegation that the removal of trees from large districts produces a sensible effect on the character and amount of the rainfall, and upon the temperature and hygrometry of the district, the extent of the British Isles is not sufficiently great to afford positive information.

2d. Sunshine, earth temperature at depths not exceeding four feet, air temperature and range humidity, wind, rain, and terrestrial radiation, also solar radiation and evaporation, if satisfactory instruments can be obtained.

3d. The additional data required would not materially increase the work at existing stations.

4th. Yes.

5th. The results of the first experiments in this country by the meteorological council are submitted herewith.¹

(h.) *Recommendations with reference to Agricultural and Forestal Meteorology.*

In reply to the formal invitations for co-operation from the International Meteorological Congress, an answer was sent that the importance of the subject was fully realized, and a hope was expressed that at a time not distant the means might be provided for this purpose.

In conversing with many officers of agricultural colleges, within the last four years, we have uniformly found a willingness to co-operate in these observations if the instruments were furnished and placed without expense, and there can be little doubt but that a sufficient interest would be taken in the subject to keep up the records when once begun.

It should be borne in mind that our climate is, upon the whole, drier than in Europe, that our prevailing winds (which, like theirs, are westerly ones) come over high mountains, which condense much of their moisture, and cross plains seldom shaded by a cloud, and, heated to a high degree by the sun, when they reach the settled portions of the Western and Southwestern States they are hot and intensely dry; while the westerly winds come from off the Atlantic, and to some extent from the waters that have been warmed by the Gulf Stream. These southwesterly winds in Western Iowa, Kansas, and Nebraska, especially in July and August, present a serious difficulty in the cultivation of some trees that can scarcely withstand their drying effect. This is especially true of the conifers, which will, in some kinds, turn red and perish, as if struck by fire.

It is to afford protection against these winds, that timber-belts afford our best chances of success, and upon their presence the successful cultivation of grains and fruits in a great degree depend. We must, therefore, from differences of position and exposure, depend upon the determination of meteorological effects by a study of their operation in our own country.

In whatever is done there should evidently be a uniformity, in order that there may be comparability as well between different periods at the same station as between different stations, and for the comparison of these with those made in foreign countries. This comparability can only be secured by a central direction, which, from its nature, can only be done by the general government.

In establishing these stations we should be fully up to the latest requirements of science, so that the future will have trustworthy data for comparisons that shall instruct and not mislead in a study of the results.

¹ These results refer to the number of predictions that had been followed by complete success, by partial success, by partial failure, and by total failure. They are given separately by months and districts, and summarize for the British Isles, for the year ending March 1, 1880, as follows: Complete success, 28 per cent.; partial success, 47 per cent.; partial failure, 20 per cent.; total failure, 5 per cent.

With the latest issues of instructions from all the observatories of this class in the world before us, there should be no difficulty in securing that uniformity and reliability that should satisfy every requirement.

The placing of the instruments should all be done, if possible, under the care of the same person, and we have estimated the expense of instruments and their placing at from \$250 to \$300 to a station. Both the field and the forest instruments should be fenced in and sheltered for protection, and the cost of this and other expenses might vary one or two hundred dollars.

In most foreign stations two readings only are made daily. The time should be punctually kept, and the duty may doubtless become irksome if not sustained by an intelligent anxiety for an accurate and acceptable record. We would deem it a wise and just policy to provide for a moderate but sufficient compensation for the time that should be punctually and faithfully given to this service. The attention given to it would not be much at one time, and it might not interfere with other employments; but it would be a task requiring constant residence and regular hours. As there are two or more sets of instruments to be read and recorded, more than twice the time would be required than in common meteorological observations. Of course their value would be less than nothing unless conscientiously and faithfully taken, and this care and attention should be paid for.

In the States of Missouri, Iowa, Kansas, Nebraska, and possibly some others, systems of meteorological observations in the interest of agriculture have been instituted under private enterprise, in some cases with State aid. It is presumed that those having charge of these would consent to harmonize their labors with those of a general plan, and, having for their end a common object, they would all of them need to be extended to meet the requirements of forestal meteorology.

If nothing more than records of temperature, winds, rainfall, and evaporation were kept, upon an inexpensive but uniform plan, and in great number, at stations properly distributed, we would be able to determine some questions of science that are as yet unknown.¹

IV.—MEASURES RECOMMENDED BY THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE IN RESPECT TO FOREST MANAGEMENT.

It is now more than eight years since this association turned its attention to the subject of forestry, with the view of devising measures that might be recommended for the promotion of this interest. In 1880 it adopted a report expressing its views upon this subject, and directed a memorial to be addressed to the executive authorities of the several States and Territories, requesting that it might, if approved, be laid before their legislatures. As this report gives a concise history of these proceedings, it is here presented as appropriately relating to the subject under consideration in this report:

(a.) Report of the Committee upon Forestry.

At a meeting of this association held at Saratoga in August last, a resolution was introduced and referred by the standing committee upon forestry, in which, in view

¹ In the Department of L'Oise, France, a scientific commission, resident in that region, have an organization for the study of meteorological phenomena, and especially the progress of storms. Their principal stations are ten in number. At Senlis the city has established a complete series of instruments, with the view of studying the influence of some forests that surround it.

of the great importance of the matter of forest protection and wood culture, the desire was expressed that some report looking toward definite action be received from this committee at the next meeting of the association.

Your published proceedings show that two reports have already been made by the committee upon forestry; but in order to present the subject in a connected form, we will here briefly review the action that has been taken in pursuance of the object mentioned.

At the session held at Portland in 1873 it was

"Resolved, That a committee be appointed by the association to memorialize Congress and the several State legislatures upon the importance of promoting the cultivation of timber and the preservation of forests, and to recommend proper legislation for securing these objects."

It was understood at the time that an amendment was adopted directing this committee to enter into correspondence with forestry associations of other countries, with the view of more effectually promoting the interests involved in this subject, but the proceedings as published do not show this fact.

A few days afterward a preliminary meeting was held at the house of Mr. George B. Emerson, in Boston, at which a majority of the committee was present, and an interchange of views was had as to the best means for carrying into effect the wishes of the association in the matter under their charge.

As the interests involved concern no particular State, but pervade the whole country, it was thought proper to bring the subject first before Congress, and a subcommittee, consisting of George B. Emerson and F. B. Hough, was appointed to give personal attention to this duty.

A memorial was prepared and sent in printed form to each member of the committee, and to other persons known to feel an interest in the subject, inviting their suggestions, and asking them to propose any modifications in the memorial that they might deem proper.

In January, 1874, this subcommittee repaired to Washington, and for preliminary consultation a meeting was held at the Smithsonian Institution, at which several members of Congress and others attended.

As the result of this conference, it was thought best to ask for the appointment of a commission similar to that previously created in the interest of fisheries, for the collection of facts and the publication of information upon the subject.

This being cordially approved by the President, the memorial of the subcommittee was transmitted by him to both houses of Congress, with the strong approval of the Commissioner of the General Land Office and of the Secretary of the Interior.

This special message of the President was referred in each House to the Committee on the Public Lands,¹ and an arrangement was made between the chairmen of these committees to the effect that the committee of the House should first examine the subject in detail, and that the Senate committee should reserve its action until the former had reported.

At this stage of the proceedings, the senior member of the subcommittee was recalled by private affairs, the other member remaining until near the close of the session.

After unforeseen delay, caused by other business having precedence in the committee, an opportunity for a hearing was given, and the question was referred to a subcommittee, consisting of Messrs. Dunnell of Minnesota, Phillips of Kansas, and Herndon of Texas. These gentlemen having faithfully examined the subject in detail, adopted a report which, being presented to the general committee and approved by them, was laid before the House with an accompanying bill on the 17th of March following.²

A hearing was afterwards given by the Senate committee, but the subject did not reach them for their action, which would doubtless have been unanimously in its favor, judging from the opinions expressed in conversation by each of the members.

In this report of the House committee they say—

"That they have given their attention to the subject and learn that the memorial above referred to was prepared by a committee of the American Association for the Advancement of Science, as the result of a discussion induced by a communication read before them at their annual session in Portland, Me., on the 21st of August, 1873, on 'The Duty of Governments in the Preservation of Forests.'

"A subject indorsed by an association embracing within its membership the highest scientific talent of the country must commend itself to our notice as worthy of attention. More especially is this notice due when their action takes the form of a recommendation to Congress upon a subject alleged to involve the government upon questions that vitally affect the interests of the whole country, and especially those of agriculture, manufactures, and commerce.

¹Senate Ex. Doc. 23 first session, Forty-third Congress.

²Report No. 259, H. R., first session, Forty-third Congress. An extra edition of 5,000 copies of this report was ordered by Congress.

"When it is further affirmed that without timely provision of law these great agencies of civilization and elements of wealth will, in the near future, be materially impaired, we cannot hesitate to give the recommendation a most careful examination, to the end that, if well founded, the measures best calculated for averting these injuries may be devised and the remedies most effectually applied.

"After as full an investigation of the question as present opportunities allow, we are convinced that the statements of the memorial are substantially true, and that it is the duty of the government to take immediate measures for ascertaining the condition and prospects of our timber supply, to the end that the future wants of the country with regard to these great interests, both in their scientific and practical relations, should be thoroughly investigated and made widely known."

The bill accompanying this report provided for the appointment of a commissioner of forestry, and afforded facilities for his researches, but failed at that session to become a law. It was not opposed in any manner, but was simply laid aside by the pressure of other measures then before Congress.

At the Hartford meeting of this association, held in 1874, a report, signed by a majority of your committee, was presented by Mr. George B. Emerson, and will be found to give the above proceedings in further detail.¹

Early in the Forty-fourth Congress the Hon. Mark H. Dunnell, who had taken particular interest in this subject, introduced, upon notice, a similar bill, which received the same reference as before. An opportunity for a hearing was given, but no report was made. Before the end of this session this gentleman, however, secured the adoption of an amendment to an act making appropriations for the current expenses of the government, in which the Commissioner of Agriculture was directed to appoint a person for prosecuting these inquiries relating to forestry, his powers and duties being similar to those specified in the bill just mentioned. This appointment was given to Dr. Franklin B. Hough, and on the 8th of December, 1877, he presented to the Commissioner of Agriculture a report upon a part of the subjects specified in the act under which this appointment was made. It was transmitted to Congress by the President on the 13th of December, and referred to the House Committee on Agriculture.

An edition of 25,000 copies of this report was ordered, but with a restriction introduced by the Printing Committee, which limited its extent to 650 pages, and compelled the omission of a part of the report.²

At the meeting of this association held at Saint Louis in 1878, a second report, prepared by the chairman of your committee, was presented, in which further details are given of these proceedings.³ It also embodies his views concerning the subject of forestry, as applied to the United States, and recites in detail the measures already adopted in various States for the encouragement of planting, with such suggestions as to him appeared most effectual for the promotion of these interests.

The Commissioner of Agriculture, deeming the authority granted under the act above mentioned as sufficient, gave directions for a continuance of these inquiries, and found means from the funds under his control for defraying the expenses. A second report was presented in January, 1879, and transmitted to Congress by the President early in February of that year. From various causes wholly foreign to the subject, but chiefly from the occupation of the members of the Committee upon Agriculture (to which it was referred) in other business more urgent, no session was held by the committee, at which a hearing could be obtained, from the time that this report was laid before them till the end of the session. In fact, the committee met but once for business during this time, and then it was wholly occupied upon another subject.

The report was therefore withdrawn at the last moment of the session, and returned to the department.

Early in 1880 a resolution was introduced in Congress, calling for a return of the report above mentioned, and it was again transmitted by the President, and at once ordered to be printed.

The Committee upon Agriculture, to whom it was referred, gave the subject a prompt and attentive hearing, and agreed unanimously to recommend the publication of 100,000 extra copies. This resolution was still pending when Congress adjourned, and lies over till next session. In the mean time the stereotyping has been going forward to completion, making a volume of 618 pages.

By the terms of law under which these labors have been done, the Commissioner of Agriculture was directed, among other things, to cause a report to be made upon the "Importation and exportation of timber and other forest products"; and the second report upon forestry will be found to embrace an exhaustive statement of this subject in its commercial aspect. It gives a complete summary of the exportation and im-

¹Proceedings of A. A. A. S., twenty-third meeting, August, 1874, pp. 29 to 40.

²Report upon Forestry, prepared under the direction of the Commissioner of Agriculture, pursuant to an act of Congress, approved August 15, 1876. By Franklin B. Hough. 8 vo., pp. 650.

³Proceedings of A. A. A. S., twenty-seventh meeting, Saint Louis, pp. 29 to 40.

portation of forest products and wood manufactures through the period of ninety years, beginning with the government in its present form, in 1789, and coming down to the close of the last fiscal year, June 30, 1879, as reported annually by the Secretary of the Treasury from the returns of collectors of customs. The arrangement of the tables will be found as uniform as the data would permit, and ample summaries, percentages, and deductions from these tables have been prepared.

The intimate relation between the timber interests of the United States and of Canada scarcely allows us to consider one without taking into account the other. It is well known that for many years the lumber products of Canada have found an extensive and ready sale within the United States, and at the same time that a large amount of the hewn timber from within the United States in the country bordering upon our northern lakes, and intended for foreign markets, has been taken down the lakes and the Saint Lawrence for shipment at Quebec. In fact, there has always existed a certain community of interest in the forests between the inhabitants of the United States and of Canada, and it may be reasonably predicted that so long as lumber and timber are produced in either of these countries they will go to supply the wants of both.

It has therefore been deemed advisable, in presenting a full view of the commerce in wood products for the United States, and in order that this branch of the subject should be as complete as possible, to enter upon a careful study of the Canadian timber trade from data published by the Dominion and the provincial governments, beginning with the date of the confederation in 1867, and coming down to the end of the last fiscal year. In some branches of this inquiry, the statistics are carried back to an earlier period, especially in regard to the passage of timber through the government slides and canals, and the inspection of lumber in the timber market of Quebec.

A careful analysis has been made of the results of inquiries instituted in recent years by committees of the Dominion Parliament, with the view of ascertaining the condition and future prospects of the timber resources of the country, and the means best adapted for maintaining these supplies, and for economizing their use.

A full account is also given of the systems of management, with respect to the timber upon the crown lands, the results of experience in former methods, and the modifications which this experience has pointed out, in perfecting the systems now in use. In this we may find suggestions applicable in some instances to the public lands of the United States, in the methods of conservation and management that may be hereafter adopted upon our public domain; in fact, from a similarity of circumstances, we have more to learn from the experience gained in American forests than from the forest administrations of Europe, where the tenure of the lands, the systems of government, forest servitudes, and the rights of communes and of individuals are so widely different.

The crown lands of Manitoba and of the northwestern territories of Canada belong to the Dominion Government, and are in care of the department of the Secretary of State, in a branch of which there is a "Dominion Lands Office."

In other parts of Canada the crown lands belong to the provinces in which they lie, and separate systems of management are provided.

In Ontario and Quebec these lands are in charge of a Commissioner of Crown Lands; in New Brunswick they are under the Surveyor-General; in Nova Scotia, under the Attorney-General; and in British Columbia, under a Chief Commissioner of Lands and Works.

In perfecting the report application was made personally or by correspondence to the several departments of the general and local governments of Canada, having official cognizance of the subject, and full series of every class of reports bearing upon the forest question were collected from them all. More than this, substantial assistance was furnished in several cases in the way of copies of documents not published, and manuscript statements explanatory of the reports. In short, these inquiries met with the most courteous attention, indicating the great interest which the question of timber supply is awakening in Canada, and affording the ground for hope that effectual measures will ere long be realized in that country for turning their remaining resources to the best account.

If they will go a step farther and secure adequate means for reproduction, the wants of the future will be assured. As an indication that one of the means most certain to secure this desirable end is well understood, we may mention that in the Province of Quebec it is no longer permitted to cut pine trees upon the public lands measuring less than twelve inches in diameter at the stump. If they could besides this secure adequate measures for the prevention of forest fires and other waste, and apply the reservations to other kinds of timber, and especially the spruce, they would have a useful system of forestry in operation.

For this second report that we are describing, a series of graphic illustrations were prepared by a skillful draftsman at the time when the statistical tables were first submitted to the department. They would fill about a hundred pages, and it was intended to reproduce them by a photo-engraving process. The addition of three more years

since made to these tables would render it necessary to reconstruct these drawings, which cannot now be done, at least for the first issue of the report.

Besides the statistical details and generalities above mentioned, the report under notice embraces the recent legislation of the general, the State, and the Territorial governments, upon the subject of timber-planting and other interests of forestry, with statements relating to the operation of these laws.

It is a significant fact that in three States where planting is perhaps of greatest need, viz, in Kansas, Nebraska, and Iowa, the premiums formerly offered for planting trees upon prairie lands were, after a few years' experience, wholly or in part withdrawn. This should not be regarded as a sign that the interest in this subject is declining, but rather that a realization of the necessity for plantations is increasing, and that, in fact, it has become so evident and convincing that it does not need a motive beyond the pecuniary interest of the owner of the land.

Furthermore, these acts, intended for encouragement, have everywhere led to fraudulent claims for premiums and exemptions, the work of planting being often done in the most superficial and indifferent manner by those whose chief object it was to secure the present benefit of these laws, rather than the more remote but substantial profits of a successful timber growth.

In the State of Nebraska, after repealing a law extravagantly liberal in its provisions, and remaining some years without any, the legislature has recently enacted a new statute upon this subject, which, after the experience of the past, may be presumed to approach more nearly the standard of greatest utility at the least expense. It is entitled "An act to encourage the growth and cultivation of timber in the State of Nebraska," and was approved February 27, 1879. Its leading provisions are as follows:

The sum of \$3.33 $\frac{1}{2}$ per acre is to be paid annually for five years from the county treasury, to the extent of not more than 3 acres, planted in belts of six rows of trees running east and west along the north or middle section lines. The trees are to be 4 feet apart in the rows, and the rows 8 feet apart, the whole being under cultivation and in good condition during the time this bounty is paid.

We deem this act altogether too specific, for it assumes that shelter is needed only on the north side of lands, and that there is no diversity in this need. It is quite evident that the aspect and circumstances of some localities might render protection desirable from other points besides the north, especially in the remote prairie States, that often suffer from the dry and heated winds from the southwest.

It would be better to leave the direction and density of these timber belts to the discretion of the planter, as his circumstances might indicate.

By another statute of recent date the State of Nebraska, in pursuance of the authority expressed in its constitution, now exempts from taxation the *increased value* of lands by reason of live fences, fruit and forest trees grown and cultivated thereon, without regard to the area planted, or the time that the plantation is maintained. We deem this a simple and effectual mode of encouragement well worthy of careful trial in the prairie States; but there should evidently be some limit to the period of exemption, to prevent the public burdens from bearing unequally upon property, for otherwise there would eventually arise a just cause of complaint from other interests. The limit might, perhaps, be extended to the time when the plantation would begin to bring a revenue to the owner.

We may here remark that this accumulation and comparison of experience in the legislation of the country, for the benefit of forest culture, may prove one of the most effectual means for bringing about that uniformity and that degree of excellence that secure the best results. We should profit from experience, where it leads to error, not less than when it is crowned with success.

Without further notice of this second report, which will soon be before the public, we will only add that Congress at its last session, after due deliberation, made provision for the continuance of these labors; that plans for special investigations in several departments of forestry are in progress, and that a third report is in course of preparation.

It will be seen from the foregoing that prominence has been given in the report now in press to the practical interests of the lumber trade. Although the question of supply is one of vital importance to the country, the one wherein most is demanded, and the only one in which the country generally will take great interest, it should be steadily borne in mind that the best service for the promotion of the material interests of forestry can be rendered through the aid of science. The prominent duties of the branch of the public service having charge of this subject, should therefore be to advance, by every means of inquiry and research within its power, our knowledge of the laws of nature concerned in forest growth, and carefully to investigate the various circumstances that lead to best results. We should have definite knowledge of the casualties that may happen, and the means by which they may be mitigated or avoided, and upon all occasions seek to utilize the discoveries of science wherever they can be applied.

In the national census of the present year provision is for the first time made for a special investigation of our forest resources, and, in the hands of Prof. C. S. Sargent and his assistants, we may expect that this work will be well done.

The only State forestry association yet organized is that of Minnesota, which is doing good service in the promotion of tree planting in the prairie regions of that State. The project of a school of forestry has been proposed in Minnesota, and a land grant for its endowment has been asked from Congress, but hitherto, as we understand, without success.

We deem it of the first importance that a better knowledge of the principles of arboriculture should be more widely diffused. It remains a question of the future as to how far a special education in this branch of applied knowledge would, at present, find adequate remuneration, unless associated with capital and sustained by an intelligent appreciation of the importance of forest culture by those having money to invest in this enterprise, which is as yet too seldom found.

In speaking of the results of associated effort in the interest of silviculture we should not fail to notice our State agricultural and horticultural societies, many of which now recognize the importance of this subject, and admit discussions bearing upon tree culture at their meetings and in their published transactions. This is particularly the case in Iowa, where much prominence is given to questions relating to the planting of groves and hedges, and premiums are offered tending to improvements in management and extension of amount done. In some of the older States, and especially in Massachusetts, much attention has been given in recent years to this subject; but in none of the States have we seen statistics of the results obtained by the offer of these premiums of the later period.

Within the last three years the Secretary of the Interior, in whose department is vested the care of the public lands, has been making commendable efforts to arrest the unlawful cutting of timber upon these lands. In this he has met with great opposition from interested parties, through the political and other influences that they have been able to bring in Congress and from delays in the courts.

The shameful extent to which these depredations have been going on through a long period of years, and, in fact, until the practice has gained from long indulgence the semblance of a right, will hereafter be looked upon as a striking evidence of the barbarism of the age.

These efforts to repress a criminal practice long sanctioned by custom have led to recent legislation in Congress upon the timber question, some of which will tend to increase rather than prevent the waste we have described.

We refer particularly to an act passed two years since, granting to the inhabitants of certain regions, where conservation is of the first importance, the unrestrained use of timber upon the public domain, for all mining and domestic purposes, without so much as the pretext of a report as to the amount taken, the least check upon its limit, or the least payment for the privilege.¹

Among these recent statutes relating to our public domain we still look in vain for the first indication of a policy tending to provide for future supplies by reservation of timber lands, except to limited extent and for naval use alone. We find no limitation in the cutting of small trees, and no protection of lands with the view of affording a new growth of timber where it has been taken away; much less do we yet find any measures for planting upon the public lands, or any stipulations requiring this to be done by settlers, except in the still recent timber-culture acts that have as yet scarcely passed through the trial of experience.

The first of these timber-planting acts was passed in 1873, and amendments have been since made as deemed necessary. If faithfully administered the law cannot fail to prove of inestimable value to the prairie States. According to this act as it now stands a man may acquire the absolute title to a quarter-section, or 160 acres of land, by planting and cultivating 10 acres of timber, there being not less than 2,700 trees to the acre. The patent is not issued until eight years after the claim is entered. The mode of preparation of the land is prescribed, and proof of successful planting must be shown.

According to the latest reports 5,157,681 acres had been entered under this act within three years, chiefly in Kansas, Dakota, Nebraska, and Minnesota. Undoubtedly some of these lands have been taken up for speculative purposes, and as little labor as possible will be spent upon them in the way of planting and improvement, while in many other instances the undertaking is assumed in good faith and with a desire to realize as much profit as possible from the cultivation.

Passing from these statements relating to American forestry, let us notice some facts of interest bearing upon the subject in Europe. As is well known, every government of Continental Europe has now in operation a system of forest management, the best

¹"An act authorizing the citizens of Colorado, Nevada, and the Territories to remove timber on the public domain for mining and domestic purposes," approved June 3, 1878.

of which provides (so far as concerns the forests owned by general and local governments and by institutions) for a perpetual supply to the full limit of their capacity for timber growth.

From this grade of excellence, requiring a special education and thorough training of agents for its maintenance fully equal to that for any branch of the public service, we have various degrees of efficiency down to that of a mere police regulation for the prevention of fires and the restraint of waste upon timber on the public domain. Yet these systems, however they may differ in details, agree in this, that unless the public interest is concerned, the owners of private estates are generally allowed to cut or plant upon their own premises as their interest decides. The exceptions to this rule are, along a frontier, where woodlands are needed for the public defense; the banks of a river liable to inundation, where materials should be at hand for the construction of barriers; upon mountains liable to erosion of torrents, or on drifting sands on the sea-shore. There may be a few other exceptions, but as a general rule the government does not often interfere with the timber upon private estates, even where it requires a notice of intention to be given before clearing is begun.

Yet upon these private lands large forests are sometimes grown for profit, and their management is often placed in the care of agents who have received the highest grade of special education for this particular service. Except in Great Britain, we believe that facilities have been provided for this special instruction in every country in Europe, either in academies where forestry is taught alone or in institutions where agriculture and other practical industries receive a share of attention.

It may be proper to notice here a change that has been taking place in recent years in the organization of these schools of forestry in Europe. In Austria a first-class school of forestry at Mariabrunn was, after more than forty years' existence, merged, in 1875, in a High School of Agriculture and Forestry in Vienna. In Bavaria the Central Forest Academy, at Aschaffenburg, still older than the one above mentioned, has been more recently united in part with the University of Munich,¹ and discussions tending to further changes, with the view of consolidation, are now in progress in other forest academies. In Prussia the two institutions at Eberswalde and at Münden still maintain a separate existence, and the former has recently commemorated the fiftieth year of its history.

In looking at the organization of these institutions, we notice a marked change in their plan, particularly in Germany. In the preparatory studies, and especially in the natural sciences and in physics, so far as they in the least concern the forester, we find a more careful division of labor, and a more earnest purpose to make these sciences to their whole extent available in their profession, instead of the elementary studies in chemistry and botany which formerly satisfied the requirements for graduation.

In all these institutions excursions and practical exercises form a regular feature in the course of education, and microscopic studies now receive much more attention than formerly.

The science at present receives a substantial support from various experimental stations in Germany, Austria, France, and other countries, in which both practical and scientific questions are carefully investigated and the results published. Among these we may prominently mention the Foresters' Experimental Union in Germany, and the experimental labors of the Austrian Ministry of Agriculture, under the direction of Baron von Seckendorff.

In recent years much interest has been manifested among investigators in Europe in determining, by instrumental observations made at comparative stations in the open fields and in the forests, the influence of the latter upon the atmosphere in their vicinity, and upon the climate of the country generally.

That forests tend to render the climate of a country more humid has been known from general observations for many centuries; and the climate of Gaul, as described by Julius Cæsar, compared with that of France at the present day, has been often cited as an instance of this fact. Yet it is only within a very recent period that anything like a full and systematic comparison has been attempted by instrumental observations.²

In selecting the location of these stations, one set of instruments placed in the open fields and the other in the woods, the former being as much as possible free from the influence of the forest, and the latter fully under its protection. Care is taken that the soil, altitude, and other circumstances, except the forest shade, are alike. Their outfit generally consists of open-air thermometers, psychrometers, rain and snow gauges, barometers, wind-vanes, and instruments for observing the evaporation from surfaces variously covered as compared with a free-water surface, the percolation

¹The first half of the course of instruction is still given at Aschaffenburg, the last half being completed at Munich.

²An account of investigations in this line down to 1872 was published in that year by the Baron von Löffelholz-Colberg, under the title of *Die Bedeutung und Wichtigkeit des Waldes*.

of water through various soils, ozone records, and observations upon the periodical phenomena of animal and vegetable life generally, so far as influenced by the seasons. In some cases the temperature of the interior of trees is recorded, and in some of the later systems of observation it has been proposed to ascertain the temperature and humidity not only of the level of the tree tops, but at a considerable height above them, the latter being obtained by the aid of masts and by captive balloons that admit of the elevation of instruments.

Without going into details of the results of these observations, we may here remark that records more or less complete in their plan have been established as follows:

In *Saxony*, from a time begun in 1862-'63, under the direction of Professor Krutzsch, of Tharand, at several stations, embracing records of temperature, humidity, rain, snow, &c.

In *Bavaria*, since 1868, seven stations have been established under Dr. Ernst Ebermayer, who in 1873 published very fully the results of four years' records,¹ and in 1876 another work upon the formation of soil from the litter of woodlands and the chemical statics of forest culture.² It was his intention at the end of ten years to publish the results of that period in more extended form, but his recent removal from Aschaffenburg to Munich has apparently postponed, if it has not disappointed, this expectation.

In *Prussia* a system of observations nearly similar to those in Bavaria was begun in 1874 under Prof. A. Müttrich, of Eberswalde, and now includes fourteen stations in Prussia, Brunswick, and Alsace Lorraine. The results are published monthly³ and annually⁴, and a careful study of so much as relates to the temperature of the soil has recently appeared.⁵

In *France*, observations upon the rain-fall in the woods and open fields were made under the direction of Marshal Vaillant, in 1866, near Paris, and published in the *Atlas Météorologique* of the Imperial Observatory of Paris for 1867. In the same year, observations of more extended character were commenced at two forest stations and one agricultural station in the vicinity of Nancy, near the eastern border of France, by Prof. A. Mathieu, of the School of Forestry at Nancy, and have since been continued. A summary of eleven years' observations was published in 1878.⁶

Upon a general suggestion of the Congress of Agriculturists and Foresters in Vienna, in 1873, M. Fautrat, a subinspector in the French Forest Service, with the approval and aid of the department, established two stations for comparative observations, one in the deciduous forest of Halatte, near Fleurines, and the other in a forest of the *Pinus sylvestris*, near the village of Thiers. The former began in February, 1874, and was continued four years; the latter began in June, 1875, and was continued three years. The results have been published by the French Forest Administration.⁷

In *Switzerland* observations were established in 1868 at three stations, by the Forest Administration of the Canton of Bern, and the results have since been published monthly in detail.⁸ One of these stations is in a forest of beech, another of fir, and another of larch. The observations upon periodical phenomena, made at numerous stations in the Canton of Bern, under the same auspices, are published annually.⁹

In *Austria* a plan of observations in Forest Meteorology has been prepared by Dr. Jos. R. Lorenz, and adopted as a part of the experimental system of researches under the general direction of Baron von Seckendorff, and under the authority of the minis-

¹*Die physikalischen Einwirkungen des Waldes auf Luft und Boden, und seine klimatologische und hygienische Bedeutung*, 1 vol., 8 vo., pp. 266 and 251 (with an atlas), Berlin, 1873.

²*Die gesammte Lehre den Waldstreu, mit Rücksicht auf die chemische Statick des Waldbaues*, 1 vol., 8 vo., pp. 300 and 116, Berlin, 1876.

³*Beobachtungs-Ergebnisse der im Königreich Preussen, im Herzogthum Braunschweig und in den Reichsländern eingerichteten forstlich-meteorologischen Stationen*, 1 bis. 5 Jahrgang, 1875-1879.

⁴*Jahresbericht über die Beobachtungs-Ergebnisse der im Königreich Preussen und in den Reichsländern eingerichteten forstlich-meteorologischen Stationen*, 1 bis. 4 Jahrgang, 1875-1878.

⁵*Beobachtungen der Erdbodentemperatur auf den forstlich-meteorologischen Stationen, in Preussen, Braunschweig und Elsass-Lothringen, von A. Müttrich*. Separate issue of the semi-centennial volume of the Forest Academy at Eberswalde, 4to, pp. 33, Berlin, 1881.

⁶*Météorologie Comparée, Agricole et Forestière*, 4to, Paris, pp. 70. Published by the Forest Administration, in connection with the Paris Exposition of 1878.

⁷*Observations Météorologiques faites de 1874 à 1878, par M. Fautrat*, 4to, pp. 4 (with eight pages of plates.)

⁸*Beobachtungs-Ergebnisse der im Kanton Bern zu forstlichen Zwecken errichteten meteorologischen Stationen*.

⁹*Klimatologische und phänologische Beobachtungen (Observations climatologiques et phénologiques) im Canton Bern*, 4 to).

try of agriculture. The plan is very comprehensive and includes some features not found in other systems, but it has not been put in operation until the present time.

In *Sweden* two scientific stations have been established by the government, one in Upland in the southeastern part, and the other at Skaarsborg. They have been in existence some three or four years, but we have not met with any publication of the results.

In *Italy* similar observations are being made at one or two stations.

In *Bohemia* a system of meteorological observations has been recently established under the auspices of the Bohemian Forest Society, and mainly in the interests of forestry, which is very comprehensive in its plan, embracing a wide range as to elevation and exposure. So far as published, these records relate to the rainfall only, the observations being made by employes of the forest administration of the country.

The number of stations at the beginning in January, 1879, was 570, and at the end of the first year it was increased to 689. In February of the present year, the number was 712.¹ The results are published monthly in detail,² but as yet without attempt at generalization beyond the monthly means and totals. The system is under the care of Dr. Emanuel von Purkyne, a professor in the forest academy of Weisswasser, and cannot fail of proving valuable to the country and to the world by making us better acquainted with the laws that govern the rainfall in a wooded country, and the circumstances that determine the amount.

Several investigations concerning the temperature of the earth at different depths below the surface, and under various conditions, have been made in Russia and elsewhere. These have more or less relation to forest meteorology, and in several of the experimental stations now in operation the result will contribute to a further knowledge of this important subject.

We regret that hitherto so little has been done in our own country for the determination of the relations between the forest and the climate by direct comparative observations. With the exception of a few desultory records of temperature and rainfall, we are not aware that any thing has yet been attempted for this object at any institution or by any observer in America.

The greater general dryness of our atmosphere and difference in our prevailing winds appear to render the application of any general laws derived from European records very unreliable with us, and we never can have a certain knowledge of these laws as they operate in our country until they shall have been determined from observations of our own.

The International Statistical Congress held at Budapest in September, 1876, the Meteorological Congress at Rome in 1877, and various conventions held by agriculturists and foresters in recent years, have had under discussion questions relating to the agricultural and industrial interests dependent upon climatic changes, and the extent to which these are modified by the woodlands of the country, and it is to be hoped that effectual co-operation in these researches will ere long be rendered by American investigators.

Among the recent researches concerning the influence of forests upon the amount of water in wells, rivers, and streams, and incidentally the effect of woodlands in maintaining the amount, we may notice as particularly worthy of attention the publications of Counsellor Gustavus Wex,³ overseer of the works of improvement in the Danube at Vienna. These memoirs are not only of interest from the facts that they embody, but also for their citations of other works, making them in some degree a bibliography of the subject. They have been referred to commissions appointed by various academies of science, and the conclusions that they present have been approved by the highest authorities. They, in fact, confirm by numerical statements the observations of every one who has had an opportunity to notice the amount of water flowing in streams before and after the clearing of the district in which they rise and through which they run. This amount affects the interests concerned in the hydraulic power of the larger streams, the supply of water to cities, and the navigation of rivers and canals.

As this diminution of water-supply is the result of man's acts, so also in a great

¹ Since the above was written the number of stations has been reduced, and is now (1882) about 325.

² *Ombrometrische Beobachtungen der böhmischen Forstvereine in den Foresten Böhmens in verschiedenen Seehöhen und Expositionen errichteten Stationen. Herausgegeben von der Forstlehranstalt Weisswasser, zusammengestellt und redigirt von Dr. Emanuel von Purkyne, Professor an der Forstlehranstalt Weisswasser. Prague, 4 to, (in monthly parts.)*

³ *Ueber die Wasserabnahme in den Quellen, Flüssen und Strömen, bei gleichzeitiger Steigerung der Hochwasser in den Culturländern, von Gustavus Wex, K. K. Ministerialrath und Oberlantier der Donauregulirung bei Wien. 4to, pp. 43, with 7 plates. Zweite Abhandlung, &c. 4to, pp. 30, with 6 plates. There are separate imprints from the Zeitschrift des österreichischen Ingenieur- und Architekten-Vereins, 1873 and 1879.*

degree is the remedy of control within his power, and by means of planting and with reservoirs he can often recover and maintain the advantage lost perhaps as fully as they existed under the primeval forests.

Among the means for the advancement of forest science in Europe, we might mention as worthy of notice the growing interest in various societies and associations formed for the discussion of new questions as they arise, the comparison of experience, and the promotion of that personal acquaintance so conducive to the general welfare. These meetings are usually enhanced in interest by excursions to forests, affording an illustration of methods or other subjects of practical interest.

The more important of the essays and discussions which these meetings call out are published with their official proceedings, and through the medium of these publications and the various journals of forestry the more important discoveries become widely known.

Returning to the original resolution under which the Committee upon Forestry was appointed by this Association, in 1873, there remains to be considered one subject that claims our careful consideration.

With the exception of a communication from its chairman to the New York legislature,¹ and one of like import by Colonel Whittlesey, another member of the Ohio legislature, no action has thus far been taken by this committee toward bringing the subject to the attention of our State legislatures. This delay has in part arisen from an uncertainty as to how far a State government may, with any prospect of success, enact laws tending to secure efficient planting upon private lands.

In European countries, where forest systems have been in full force for centuries, it is only within a quite recent period that the owners of a minority interest in a large and connected body of woodlands could be compelled to join a controlling majority in assisting to maintain a system of management under one direction, the costs and profits of forest management being shared in proportion to the proprietary rights. It is still almost invariably the rule that the owners of private woodlands have a full right to manage them as their interests lead, excepting in cases where the public welfare is concerned, and it is the universal experience of all countries that the owners of the soil are jealous of interference with what they regard as their rights in the cultivation of their own land.

This is particularly true in our own country, where "*liberty and independence*" have been the watchwords from the beginning, and where the widest range of freedom is allowed in the enjoyment of every kind of property, provided only that no injury is done to the public or to the rights of others.

We cannot therefore entertain the idea of an edict that every man shall plant a given portion of his land with forest trees. Our people must be educated to a knowledge of the situation, and familiarized with the means by which benefits may be gained or injuries avoided. With the great majority the effect of scarcity upon the market prices of lumber will be of more interest than the influence of forests upon the climate; and the public generally will give more attention to questions of gain or loss than to all that science teaches about the hidden causes that produce these results.

We accordingly deem it best only to recommend a series of measures tending to familiarize our people with ideas of the importance of forest culture, and to make them better acquainted with the means by which its advantages may be secured. It may be reasonably hoped that public opinion will by these means be led to sustain such other measures as further experience may warrant or suggest.

The following form of a memorial is therefore submitted for your consideration. If approved we would suggest that it be forwarded in duly authenticated form, as the recommendation of this association, to the chief executive officer of each State and Territory of the United States, with a request that the same may be submitted to the several legislatures.

And your committee, having now served for seven years, and performed their duty to the best of their ability and opportunity, ask to be discharged.

FRANKLIN B. HOUGH.
LEWIS H. MORGAN.
ASA GRAY.
CHARLES WHITTLESEY.

¹Senate Document 82, 1875.

(b.) Memorial.

To his Excellency the Governor of ——— :

The American Association for the Advancement of Science, at its meeting held in Boston on the 30th day of August, 1880, having considered and adopted the following memorial, has instructed the undersigned to transmit the same to your Excellency, and respectfully ask that it may be laid before the Legislature of your State at its next session:

MEMORIAL OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE,
IN RELATION TO THE NEED OF ATTENTION TO OUR FUTURE FOREST SUPPLIES.

To the Honorable the Legislature of the State of ——— :

We would earnestly invite the attention of your honorable body to the great and increasing importance of providing, by adequate legislation, for the protection of the existing woodlands of the country against needless waste, and for the encouragement of measures tending to the more economical use and the proper maintenance of our timber supply.

It is evident that the consumption and waste of the forests of the country much exceed their restoration by natural growth, that the native supply of timber of the better qualities is rapidly becoming less, and that the demand for building purposes, manufactures, and other uses, is rapidly increasing from year to year.

This decreasing supply and growing consumption must ultimately lead to serious inconvenience, and may, unless seasonably prevented, occasion great public injury, by leaving the future without adequate supplies.

We deem it an established fact, that the interests of Agriculture are promoted by the presence of a due proportion of Woodlands in a country, and that they suffer when clearings are created to excess. The protection which they afford appears to mitigate, in a sensible degree, the vicissitudes of Climate, and to maintain the supply of water in springs, rivulets, and wells. They shelter a country from injurious winds, and may be made practically useful in preventing the drifting of snows and sands in preventing or diminishing damages from torrents, and in limiting unhealthy emanations from marshes. Their influence in connection with questions of water supply for cities, and the maintenance of hydraulic power, and of navigation in rivers and canals, where these may be affected by droughts, deserves serious attention.

But it is especially to the Woodlands, as a source of supplying materials of first necessity to the country that we would respectfully invite the attention of your Honorable Body; and here we would remark, that a realizing sense of the importance of this subject has long since led the principal governments of Europe to enact laws and establish regulations for the maintenance of a due proportion of Forests upon the Public Domains, and upon the lands belonging to Local Municipalities and Public Institutions.

We are aware that wide differences exist in the tenure of land in the United States as compared with those of Europe, and that the titles to landed property are here very generally vested in their owners without any conditions whatever as to Timber Culture.

It is also true that in most of the older and in some of the newer States there are no lands whatever adapted to this use now belonging to either the State or the Local Governments, the whole being owned by private citizens, and subject to no conditions but such as their Representatives in a Legislative capacity may establish for the general welfare.

It is to the owners of the land that we must therefore look for the adoption of measures tending to avert the injuries in prospect; and in furtherance of this end we deem it within the province of a State Legislature to encourage the enterprise, which may be done in a good degree in the following manner:

1. By a law protecting Trees planted along the Highways, and encouraging such plantations by deductions from Highway Taxes. It may, in particular cases, be proper to require such plantations to be made at the public expense, with the view of protecting roads from drifting snows, or for other local benefits, and in a manner best calculated for securing these objects.

2. By a law that shall exempt from taxation the increased value of land from the planting of trees, where none were growing, for such period as may appear proper, or until some profit may be realized from the plantation.

3. By the appropriation of money to Agricultural and Horticultural Societies, to be applied as premiums for tree planting, regard being had to greatest areas planted and the most successful management. Reports should be required, giving details of the methods found most effectual in obtaining these results.

4. By prizes for the best Essays and Reports upon subjects of practical Forest Culture,

to be awarded by competent judges, and those approved to be published for distribution among those who would be the most benefited by this information.

5. By encouraging Educational Institutions within the State to introduce a course of instruction having reference to practical Sylviculture.

This object may be promoted by the aid of Collections, and by correctly labeling Plantations of the various species of Forest Trees adapted to the soil and climate. At Agricultural Colleges, and at higher Institutions of Learning, stations might be advantageously established under State patronage, for experiments and observations in cultivation and acclimatization. The distribution of seeds and plants affords a direct and efficient aid in the promotion of an interest in this subject.

6. By laws tending to prevent Forest-fires, by imposing penalties against the willful or careless setting of such fires, and by enlarging and defining the powers of Local Officers in calling for assistance, and in adopting measures for suppressing them. The waste from this cause, in some years, greatly exceeds the amount of timber used, and there is no question connected with forest supplies that demands more serious attention. Our main reliance appears to depend upon vigilant precautions, enforced by adequate penalties, and sustained by a strong public sentiment.

7. Under favorable circumstances Model Plantations might be established and maintained by the State Government, under the care of persons specially trained to the profession of Forestry. Their location should be chosen with a view of affording convenient opportunity to those who might wish to learn improved methods of management by the study of a work worthy of imitation.

8. The appointment of a Commission of Forestry under State authority (analogous to the Commission of Fisheries in many of the States) might prove of great service, in promoting efficient measures for the advancement of this interest. The Members of such a Commission, who would doubtless be selected on account of their influential standing and their known intelligence upon this subject, would be able to study the conditions and requirements of their State, and devise means for most effectually securing the object in view.

In questions arising upon this subject we depend much upon the intelligence of our fellow-citizens, who are not generally slow to appreciate advantages, or to foresee a real danger where the indications are apparent. When this danger is fully realized, we believe that no time will be lost in seeking to apply the remedy. The measures we recommend will tend to awaken an interest in the subject and lead to an intelligent understanding of the means for meeting the dangers that may arise from undue exhaustion of our forest supplies. They will diffuse the benefits gained by experience for the good of all, and educate public opinion to a degree that will sustain more energetic measures, as their necessity may be hereafter more fully known.

Chairman of the Committee, A. A. A. S.

V.—THE CARE OF TIMBER LANDS FOR THE PRODUCTION OF CHARCOAL.

(a.) *Suggestions for management.*

In the first establishment of forges or furnaces using charcoal as a fuel, the cost is closely related to the expenses of manufacture and transportation, and the value of the timber does not begin to be seriously felt until by use, or forest fires, the supplies begin to fail.

In older countries this experience has led to plans of management, with the view of maintaining these supplies by natural growth. This is often secured very effectually by carefully observing the proper season for cutting the wood, so that a new crop may spring up from the sprouts, by carefully excluding domestic animals, where their pasturage would injure the young growth, and by vigilant care in preventing, and prompt action in extinguishing, forest fires.

In order that a supply may be permanent, a given woodland should be of sufficient extent to admit of division into as many portions as there are years in the proposed periods of cutting. If the demand is uniform, these portions will be equal as to productive capacity, and it is well to have them definitely marked. In European forests this is often done by trenches, but, what is often better, by open avenues that should be kept as free as possible from light combustible materials, so as to serve at the same time as safety belts in case of fires. They should

be so regulated as to age that one of these divisions will be of the size proposed for cutting every year, and the cutting should be done at one time, and in the latter part of winter, or at least always in the period of suspended vegetation, care being taken to preserve the young trees, and to leave the stumps low and smoothly cut, so as to favor the growth of sprouts.

As timber becomes more valuable, there would be great economy in reserving thrifty young trees of unusually fine body for growth till the end of the next period, or for a longer time, when their timber will be worth much more for manufacture or for building purposes than for charcoal. But the number of these reserves should not be so great as to hinder the growth of underwood, and much will depend in their selection upon the conditions of soil, the probable value of products when cut, and other circumstances that must be decided by the judgment of the manager.

There is a further advantage from these reserves in affording seed for starting new plants, and here, by a selection of kinds most desirable, the prevailing character of the woodland, and its profits, may be in a measure controlled. There are, however, some species technically known as "white woods" that are only too ready to disseminate their seeds, and to crowd out those of more value, unless this tendency is controlled by judicious thinning.

A mixture of trees will often produce more wood to an acre than where all are of one kind. The beech among oaks and firs is mentioned as an example. Of course, where the soil, aspect, or altitude present conditions that are favorable to any particular trees, either from rapid growth or excellence of quality, the opportunity should be improved to the most profit.

A dense growth produces less material in a given time, and where trees are to be grown to large size, for important uses, it is necessary to thin out the smaller and feebler trees to give the larger and stronger ones a better exposure to the air and light. This is not generally practiced in a coppice growth, but there are cases in which it would be advisable. As void spaces appear in a woodland they should be filled by raking in seeds of trees in the early spring, or by transplanting. Dead and decaying trees should be taken out while of some worth, and those of the coniferous kinds as soon as may be, to prevent the harboring of noxious insects. If nothing more is done, the taking off and burning of their bark will sometimes prevent them from becoming centers of infection, to the damage of surrounding trees.

In nearly level grounds the accidental obstruction of a stream on the outlet of a swamp, such as that caused by the fall of a tree, will change the level of standing water and do injury to standing timber—in some cases over an extensive area. A little timely notice may save losses from this cause.

There are further economies relating to the saving of volatile products in the preparation of charcoal, and an increase of quantity and quality of the yield, by methods that come within the province of experiment and inquiry; but that cannot well be here considered. With the view of obtaining information concerning the results of experience or of usage in the measurement of charcoal, its yield and cost, the areas required for permanent supply, and the relative advantages from burning in meilers [coal-pits] or in kilns, and other facts of practical value, a circular was addressed by the Department in October, 1880, to the proprietors and managers of forges and furnaces using charcoal as a fuel. The results of these inquiries are given in the following tables. They

present many facts that will have interest with those who furnished this information, and afford the data for comparison.

(b.) *Uncertainty with respect to the Charcoal Bushel.*

In this connection we wish to call particular attention to the lack of uniformity in the capacity of the "bushel" in measuring charcoal. In some cases the size is fixed by law, in others by custom. There is no great chance of a misunderstanding between producer and consumer in these cases, as they both doubtless understand alike in their agreement, but these differences afford a great opportunity for confusion, where they appear in statistics, as for example in the amount of charcoal required in making a ton of iron, or the percentage of weight and volume of charcoal in a cord of wood or from a given area of land. It is a question worthy of consideration as to whether this does not come within the province of Congress to regulate, as in the case of weights and measures generally.

It is furthermore suggested and earnestly recommended that inasmuch as uniformity can only be secured by a change, that we should at the same time take a unit that will be most likely to satisfy all the needs of coming time.

We find already established as obligatory in most European countries, and as permissive in our own, the *metrical system*, the distinguishing feature of which is the facility of comparison that it allows upon the decimal basis.

The unit of measure for charcoal in the metrical system is the *hectoliter*, a term now common in all scientific reports, and continually occurring in the metallurgical estimates and official statements. The *hectoliter* is equivalent to 2.837 *bushels*, and the *quarter hectoliter* (0.709 bushel) or *half hectoliter* (1.418 bushels) might be conveniently used.

If an objection were made to the use of long and strange words, the word "measure," or some other familiar term which does not now imply a definite quantity, might be used. The purchasers, as well as those who sell, would as readily get accustomed to "measures of charcoal" as they now are to "bushels of charcoal," and with a much greater certainty as to what they intended than at present.

(c.) *Statistical Summary of Returns.*

(1.) *Capacity of the Bushel of Charcoal, as determined by law or usage in the several States reporting.*

[Answers from circulars.]

| States. | No. of returns received. | Capacity and remarks. |
|-------------------|--------------------------|---|
| Alabama..... | 4 | In cubic inches: 2,688 in two; 2,688 and sometimes 2,750 in one; 2,700 in one. |
| Connecticut | 2 | In cubic inches: 2,564 in two. |
| Georgia..... | 2 | In cubic inches: 2,760 in one; 2,768 in one. |
| Kentucky | 4 | In cubic inches: 2,688 in three; 2,748 in one. |
| Maine | 1 | In cubic inches: 2,688 in one. |
| Maryland..... | 5 | In cubic inches: 2,250 in two; 2,450 in one; 2,666 $\frac{2}{3}$ in one; 2,747 $\frac{7}{10}$ in one. |
| Massachusetts... | 1 | In cubic inches: 2,566 in one. |
| Michigan | 7 | In cubic inches: 2,688 in one; 2,700 in one; 2,740 in two; 2,744 in one; 2,748 in two. |

| States. | No of returns received. | Capacity and remarks. |
|---------------------|-------------------------|---|
| Minnesota | 1 | In cubic inches: 2,748 in one. |
| Missouri | 3 | In cubic inches: 2,680 in two; 2,688 in one. |
| New Jersey | 2 | In cubic inches: 2,400 and 2,700 in one; 2,600 in one. |
| New York | 4 | In cubic inches: 2,688 in three; 2,780 in one. |
| North Carolina .. | 1 | In cubic inches: 2,800 in one. |
| Ohio | 13 | In cubic inches: 2,688 in thirteen. |
| Oregon | 1 | In cubic inches: 2,844 in one. |
| Pennsylvania | 16 | In cubic inches: 2,150½ in one; 2,400 in one; 2,500 in one; 2,550 in two; 2,571 in three; 2,572 in one; 2,578 in one; 2,748 in two. In pounds: 20 in four. |
| Tennessee | 4 | In cubic inches: 2,688 in four. |
| Virginia | 11 | In cubic inches: 2,150 in two; 2,250 in one; 2,686 in one; 2,687 in three; 2,687½ in one; 2,688 in three. |
| Vermont | 1 | In cubic inches: 2,650 in one. |
| West Virginia .. | 1 | In cubic inches: 2,571 in one. |
| Wisconsin | 3 | In cubic inches: 2,696 in one; 2,748 in two. |
| General Total | | In cubic inches: 2,150 inches in two; 2,150½ in one; 2,250 in three; 2,400 in two; 2,450 in one; 2,500 in one; 2,550 in two; 2,564 in four; 2,566 in one; 2,571 in four; 2,572 in one; 2,600 in one; 2,650 in one; 2,666½ in one; 2,680 in two; 2,687 in three; 2,687½ in one; 2,688 in thirty-two; 2,696 in one; 2,700 in three; 2,740 in two; 2,747½ in one; 2,748 in eight; 2,750 in one; 2,760 in one; 2,768 in one; 2,780 in one; 2,800 in one; 2,844 in one; 20 pounds in four. |

(2.) *Capacity of the Bushel as fixed by Law or Custom in the several States and Territories.*

[From the Journal of the United States Association of Charcoal Iron Workers, vol. 2, No. 6, p. 347.]

| Designation of bushels. | Cubic inches. | Cubic feet. | Standard bushels (2,748 cubic inches) equal to 100. |
|--|---------------|-------------|---|
| New Hampshire standard | 1,989 | 1.151 | 72.4 |
| New York standard | 2,150.42 | 1.244 | 78.3 |
| Minnesota standard | 2,419.5 | 1.4 | 88 |
| Rhode Island standard | 2,481 | 1.436 | 90.3 |
| Connecticut standard | 3,159 | 1.828 | 114.9 |
| Massachusetts standard | 2,564 | 1.483 | 93.8 |
| Pennsylvania standard | 2,566 | 1.484 | 93.4 |
| Montana Territory standard | 2,571 | 1.488 | 93.6 |
| Missouri standard | 2,650 | 1.534 | 96.4 |
| Winchester standard | 2,680 | 1.55 | 97.5 |
| Baltimore standard | 2,688 | 1.556 | 97.8 |
| Our standard, as adopted by resolution of the association..... | 2,747.7 | 1.59 | 99.9 |
| Oswego Iron Company (Oregon) standard | 2,748 | 1.59 | 100 |
| | 2,844 | 1.646 | 103.5 |
| | 2,000 | 1.157 | 72.8 |
| | 2,200 | 1.273 | 80 |
| | 2,500 | 1.362 | 81.9 |
| | 2,300 | 1.331 | 83.7 |
| Various standard bushels in use at individual iron works .. | 2,350 | 1.360 | 83.5 |
| | 2,400 | 1.389 | 87.3 |
| | 2,450 | 1.418 | 89.1 |
| | 2,500 | 1.447 | 90.9 |
| | 2,550 | 1.476 | 92.8 |
| | 2,600 | 1.505 | 94.6 |
| | 2,700 | 1.563 | 98.3 |
| Swedish standard for charcoal: | | | |
| Tønna | | 5.823 | 366 |
| Last, or stüg | | 69.876 | 4,394 |

STATISTICS OF CHARCOAL.

(3.) Quantity of Charcoal used.

| States. | No. of returns. | Bushels used in 1880. | | Estimated No. of bushels used in 1881. | |
|---------------------|-----------------|-----------------------|-----------------------|--|-----------------------|
| | | Total. | Average. | Total. | Average. |
| Alabama | 4 | 3,385,879 | 846,407 $\frac{1}{2}$ | 3,925,000 | 981,250 |
| Connecticut | 2 | 1,500,000 | 750,000 | 1,700,000 | 850,000 |
| Georgia | 2 | 854,230 | 427,115 | 1,400,000 | 700,000 |
| Kentucky | 4 | 2,424,800 | 606,200 | 2,524,800 | 631,200 |
| Maine | 1 | 500,000 | 500,000 | 600,000 | 600,000 |
| Maryland | 6 | 4,070,534 | 678,422 $\frac{1}{2}$ | 4,105,000 | 684,166 $\frac{2}{3}$ |
| Massachusetts | 1 | 1,074,155 | 1,074,155 | 1,200,000 | 1,200,000 |
| Michigan | (a.) | 7,472,303 | 934,037 $\frac{2}{3}$ | 8,863,275 | 984,808 $\frac{1}{3}$ |
| Minnesota | 1 | 384,466 | 384,466 | 900,000 | 900,000 |
| Missouri | 3 | 2,240,000 | 746,666 | 3,250,000 | 1,416,666 |
| New Jersey | 3 | 348,000 | 116,000 | 490,000 | 163,333 |
| New York | 5 | 1,742,500 | 348,500 | 1,950,000 | 390,000 |
| Ohio | 13 | 6,295,534 | 484,272 | 6,316,000 | 485,846 |
| Oregon | 1 | 660,750 | 660,750 | 1,000,000 | 1,000,000 |
| Pennsylvania | (b.) | 4,555,255 | 303,681 | 3,895,000 | 299,615 |
| Tennessee | (c.) | 1,438,000 | 359,500 | 1,658,000 | 552,666 |
| Virginia | (d.) | 1,890,000 | 189,000 | 2,260,000 | 282,500 |
| Vermont | 1 | 212,060 | 212,000 | 400,000 | 400,000 |
| West Virginia | 1 | 60,000 | 60,000 | 250,000 | 250,000 |
| Wisconsin | 3 | 2,391,733 | 797,244 $\frac{1}{3}$ | 2,435,128 | 811,709 $\frac{1}{3}$ |

General total of amount reported as used in 1880 58,465,139
 General total of amount reported to be used in 1881 47,082,205

- (a.) Eight returns for the year 1880, and seven for the year 1881.
 (b.) Fifteen in 1880, and thirteen in 1881.
 (c.) Four in 1880, and three in 1881.
 (d.) Ten in 1880, and twelve in 1881.

(4.) Cost of Charcoal.

| States. | Cost per bushel. |
|---------------------|---|
| Alabama | 5 $\frac{1}{2}$ cents in one; 5 to 6 cents in one; 6 to 7 cents in one; 7 cents in one. |
| Connecticut | 8 $\frac{1}{2}$ to 10 cents in one; 10 to 11 cents in one. |
| Georgia | 5 cents in one; 6 $\frac{1}{2}$ cents in one. |
| Kentucky | 4 $\frac{1}{2}$ cents in one; 5 $\frac{1}{2}$ cents in one; 5 $\frac{1}{2}$ to 6 cents in one; 6 to 6 $\frac{1}{2}$ cents in one. |
| Maine | 5 to 7 cents in one. |
| Maryland | 6 cents in one; 7 cents in one; 7 $\frac{1}{2}$ cents in one; 8 cents in three. |
| Massachusetts | 10 cents in one. |
| Michigan | 5 $\frac{1}{2}$ cents in one; 6 cents in one; 6 $\frac{1}{2}$ cents in one; 7 cents in one; 8 cents in four; 9 cents in one. |
| Minnesota | 7 cents in one. |
| Missouri | 6 cents in one; 6 $\frac{1}{2}$ cents in one; 7 cents in one. |
| New Jersey | 8 cents in one; 8 $\frac{1}{2}$ cents in one; 8 to 16 cents in one. |
| New York | 6 cents in two; 6 $\frac{1}{2}$ cents in one; 10 cents in two. |
| Ohio | 4 to 6 cents in one; 5 cents in one; 5 to 5 $\frac{1}{2}$ cents in one; 5 to 6 cents in two; 5 $\frac{1}{2}$ to 6 cents in one; 6 cents in one; 6 $\frac{1}{2}$ cents in one; 6 $\frac{1}{2}$ cents in two; 6 $\frac{1}{2}$ to 8 cents in one; 6 to 7 cents in one. |
| Pennsylvania | 5 $\frac{1}{2}$ cents in one; 6 cents in three; 6 $\frac{1}{2}$ cents in one; 6 $\frac{1}{2}$ cents in one; 7 cents in three; 7 $\frac{1}{2}$ cents in three; 8 cents in one; 9 cents in one; 9 to 15 cents in one. |
| Tennessee | 3 $\frac{1}{2}$ cents in one; 4 cents in two; 4 $\frac{1}{2}$ cents in one; 6 to 6 $\frac{1}{2}$ cents in one. |
| Virginia | 4 $\frac{1}{2}$ cents in one; 5 cents in three; 5 to 6 cents in two; 6 cents in three; 6 to 7 cents in one. |
| Vermont | 9 to 10 cents in one. |
| West Virginia | 4 cents in one. |
| Wisconsin | 6 cents in one; 7 cents in one; 7 $\frac{1}{2}$ cents in one. |
| General total | 3 $\frac{1}{2}$ cents in one; 4 cents in three; 4 $\frac{1}{2}$ cents in one; 4 $\frac{1}{2}$ cents in two; 4 to 6 cents in one; 5 cents in five; 5 $\frac{1}{2}$ cents in two; 5 $\frac{1}{2}$ cents in one; 5 $\frac{1}{2}$ cents in one; 5 to 5 $\frac{1}{2}$ cents in one; 5 to 6 cents in five; 5 to 7 cents in one; 5 $\frac{1}{2}$ to 6 cents in two; 6 cents in twelve; 6 $\frac{1}{2}$ cents in three; 6 to 6 $\frac{1}{2}$ cents in two; 6 to 7 cents in three; 6 $\frac{1}{2}$ cents in five; 6 $\frac{1}{2}$ to 8 cents in one; 7 cents in eight; 7 $\frac{1}{2}$ cents in four; 7 $\frac{1}{2}$ cents in one; 8 cents in nine; 8 $\frac{1}{2}$ cents in one; 8 to 16 cents in one; 8 $\frac{1}{2}$ to 10 cents in two; 9 to 10 cents in one; 9 to 11 cents in two; 9 to 15 cents in one; 10 cents in three; 10 to 11 cents in one. |

(5.) *Cost of labor in cutting wood.*

| States. | Per cord. | Per 100 bushels. |
|--------------------|---|--|
| Alabama..... | 50 cents in two; 50 to 60 cents in one.. | \$2 in one; \$2.75 in one; \$4.25 in one. |
| Connecticut..... | 50 to 75 cents in one; 75 cents in one.. | \$1 in one; \$4.75 to \$5.50 in one. |
| Georgia..... | 50 cents in one..... | \$4 in one. |
| Kentucky..... | 35 cents in one; 35 to 40 cents in two; 45 to 50 cents in one. | \$3 to \$3.25 in one. |
| Maine..... | 60 cents in one..... | \$2.50 in one. |
| Maryland..... | 35 to 40 cents in one; 40 cents in one; 50 cents in three. | \$1.25 in two; \$1.25 to \$1.50 in one; \$1.50 in one. |
| Massachusetts..... | 75 cents in one..... | \$3 in one. |
| Michigan..... | 60 cents in one; 75 cents in three; 75 to 80 cents in one; 80 cents in one.. | \$1 in two; \$1.25 in one; \$1.37 in one; \$1.50 in one; \$2 in one. |
| Minnesota..... | 80 to 90 cents in one..... | |
| Missouri..... | 50 cents in three..... | \$1.75 in one; \$2.75 in one; \$3.74 to \$4 in one. |
| New Jersey..... | 75 cents in one..... | \$2.50 in one. |
| New York..... | 50 cents in two; 50 to 60 cents in one; 60 cents in two. | \$1.25 in three; \$1.50 in one; \$4 to \$5 in one. |
| Ohio..... | 30 to 32½ cents in one; 30 to 50 cents in one; 33½ to 45 cents in one; 33½ to 50 cents in one; 35 to 40 cents in one; 40 cents in two; 40 to 50 cents in three; 40 to 60 cents in one; 50 cents in one. | \$1.25 to \$1.75 in one; \$1.50 in one; \$1.50 to \$2 in one; \$1.75 to \$2 in one; \$2.25 in one; \$2.25 to \$3 in one; \$3 12½ to \$3.25 in one; \$3.25 in one; \$2.50 to \$3.00 in one; \$3.25 to \$4 in one; \$3.50 in one; \$5 in one. |
| Oregon..... | 90 cents in one..... | |
| Pennsylvania..... | 33½ cents in one; 35 cents in one; 35 to 40 cents in one; 35 to 45 cents in one; 37½ to 40 cents in one; 40 cents in six; 40 to 50 cents in one; 50 cents in one. | \$1.15 in one; \$1.25 in three; \$1.25 to \$1.40 in one; \$1.40 in two; \$1.50 in two; \$1.75 in one; \$1.75 to \$2.26 in one; \$2 in one. |
| Tennessee..... | 40 cents in three; 40 to 50 cents in one.. | \$3.50 in one; \$4 in two; 50 cents in one; \$1 in one. |
| Virginia..... | 40 cents in six; 40 to 45 cents in two; 45 cents in two; 45 to 50 cents in one. | \$1.12½ in one; \$1.25 in three; \$1.25 to \$1.50 in one; \$1.33½ in one; \$1.50 in one; \$3 in one; \$4.50 in one. |
| Vermont..... | 70 cents in one..... | \$1.25 in one. |
| West Virginia..... | 50 cents in one..... | \$1.25 in one. |
| Wisconsin..... | 60 cents in one; 75 cents to \$1 in one; 80 cents in one. | \$1.25 in one; \$3 in one. |
| General total... | 30 to 33½ cents in one; 30 to 50 cents in one; 33½ cents in one; 33½ to 45 cents in one; 33½ to 50 cents in one; 35 cents in two; 35 to 40 cents in five; 35 to 45 cents in one; 37½ to 40 cents in one; 40 cents in seventeen; 40 to 45 cents in two; 40 to 50 cents in five; 40 to 60 cents in one; 45 cents in two; 45 to 50 cents in two; 50 cents in fourteen; 50 to 60 cents in two; 50 to 75 cents in one; 60 cents in five; 70 cents in one; 75 cents in seven; 75 to 80 cents in one; 75 cents to \$1 in one; 80 cents in two; 80 to 90 cents in one; 90 cents in one. | |

(6.) *Time required for reproduction of Forests.*

| States. | Time required for reproduction. |
|----------------------|--|
| Alabama..... | 15 to 18 years in one; 25 years in one; 30 years in one. |
| Connecticut..... | 25 to 30 years in one; 30 years in one. |
| Georgia..... | 15 to 20 years in one; 30 years in one. |
| Kentucky..... | 15 to 20 years in one; 20 to 25 years in one; 30 years in two. |
| Maine..... | 25 years in one. |
| Maryland..... | 18 to 20 years in one; 18 to 35 years in one; 20 years in one; 30 years in one. |
| Massachusetts..... | 30 to 35 years in one. |
| Michigan..... | 40 years in one. |
| Missouri..... | 15 years in one; 20 to 60 years in one; 40 years in one. |
| New Jersey..... | 25 to 40 years in one. |
| New York..... | 15 to 25 years in one; 20 years in two; 30 years in one. |
| Ohio..... | 15 to 25 years in one; 16 to 25 years in one; 20 years in two; 20 to 25 years in two; 20 to 30 years in two; 22 to 25 years in one; 25 years in one; 25 to 40 years in one. |
| Oregon..... | 20 years in one. |
| Pennsylvania..... | 15 to 18 years in one; 15 to 20 years in one; 20 years in one; 20 to 25 years in one; 20 to 30 years in one; 25 years in three; 25 to 30 years in four; 30 years in one; 30 to 35 years in one; 30 to 40 years in one. |
| Tennessee..... | 15 to 30 years in one; 23 to 30 years in one; 30 years in two; 30 to 35 years in one. |
| Virginia..... | 12 years in one; 15 years in one; 20 years in one; 20 to 25 years in five; 20 to 30 years in one; 25 years in one. |
| Vermont..... | 30 to 50 years in one. |
| West Virginia..... | 25 years in one. |
| Wisconsin..... | 25 years in one; 30 to 40 years in one. |
| General average..... | About 25 years. |

(7.) *Number of Acres required for permanent Operation.*

| Total number of acres. | Estimated average number of acres required annually. |
|--|--|
| 2,500 in one; 3,000 in one; 4,500 in two; 5,000 in two; 6,000 in two; 6,170 in one; 6,500 in one; 7,000 in two; 7,500 in one; 8,000 in two; 10,000 in eleven; 11,000 in two; 12,000 in six; 12,500 in two; 15,000 in three; 16,000 in two; 19,000 in one; 20,000 in three; 25,000 in three; 27,000 in one; 27,500 in one; 28,500 in one; 33,000 in three; 35,000 in one; 40,000 in two; 42,000 in two. | 100 in two; 103 in one; 110 in one; 120 in one; 140 in two; 147 in one; 150 in one; 200 in one; 205 in one; 214 in one; 238 in one; 240 in one; 250 in two; 261 in one; 275 in one; 300 in one; 305 in two; 333 in one; 350 in one; 370 in two; 400 in five; 417 in one; 425 in one; 463 in one; 480 in three; 500 in seven; 522 in one; 550 in two; 588 in one; 600 in four; 620 in one; 625 in one; 632 in one; 640 in one; 652 in one; 666 in one; 681 in one; 714 in one; 800 in four; 830 in two; 869 in one; 890 in one; 1,480 in one; 1,521 in one. |

(8.) *Charcoal burned in Meilers; Size and Yield.*

| States. | No. of returns. | Number of cords in a pit. | Average number. | Yield in bushels. | Average yield. |
|---------------------|-----------------|---|-----------------|---|----------------|
| Alabama | 3 | 40 in two; 45 in one | 41½ | 38½ in one; 40 in one; 1,300 bushels, in 40 cords, in one. | 37 |
| Connecticut | 2 | 25 in one; 25 to 50 in one.... | 31½ | 30 to 40 in one; 33½ in one.... | 34½ |
| Georgia | 2 | 35 to 50 in one; 40 in one.... | 42½ | 33½ in one; 40 in one | 37 |
| Kentucky | 4 | 35 to 40 in one; 40 to 75 in one; 40 in two. | 39½ | 35 to 40 in one; 45 in two.... | 42½ |
| Maine | 1 | 25 to 30 in one..... | 27½ | 33 to 36 in one..... | 34½ |
| Maryland | 4 | 20 to 40 in one; 25 to 30 in one; 25 in one; 25 to 35 in one. | 28+ | 35 in one; 35 to 40 in one; 37 in one; 50 in one. | 40 |
| Massachusetts | 1 | 25 in one. | 25 | 40 in one..... | 40 |
| Michigan | 4 | 20 in one; 30 in one; 40 in one. | 30 | 30 in one; 35 in one; 40 in one; 40 to 44 in one. | 36½ |
| Minnesota | 1 | | | 40 in one..... | 40 |
| Missouri | 3 | 30 to 40 in one; 40 in two.... | 38½ | 40 in two; 46 in one..... | 42 |
| New Jersey | 1 | 25 in one | 25 | | |
| New York | 3 | 15 to 30 in one; 25 in one; 30 in one. | 25 | 35 to 45 in one; 40 in one; 44 in one. | 41½ |
| Ohio | 12 | 20 to 70 in one; 25 to 60 in one; 30 to 40 in two; 35 in one; 35 to 40 in two; 40 in four; 40 to 50 in one. | 39 | 33½ in one; 33½ to 40 in one; 35 in two; 35 to 40 in one; 36 in one; 40 in six; 40 to 45 in one. | 41½ |
| Oregon | 1 | 40 in one..... | 40 | 50 in one | 50 |
| Pennsylvania | 14 | 25 in one; 25 to 30 in two; 25 to 35 in one; 30 in one; 30 to 35 in two; 30 to 50 in two; 35 in one; 35 to 45 in two; 40 in two; 40 to 60 in one. | 30 | 25 in two; 25 to 28 in one; 25 to 30 in two; 26 in one; 30 in five; 30 to 33 in one; 30 to 40 in one; 35 in one; 36 in one. | 29½ |
| Tennessee..... | 5 | 30 in one; 30 to 40 in one; 35 to 45 in one; 50 to 60 in one; 60 in one. | 44 | 33 in two; 33½ in one; 33 to 36 in one; 35 in one. | 33½ |
| Virginia..... | 11 | 25 in one; 25 to 40 in one; 20 to 60 in one; 30 in four; 30 to 40 in two; 33 to 35 in two. | 33 | 30 in one; 33 in one; 33½ in four; 33 to 40 in one; 35 in two; 35 to 40 in one; 40 in one. | 35 |
| Vermont | 1 | 15 to 50 in one..... | 32½ | 30 to 40 in one..... | 35 |
| West Virginia | 1 | 35 in one..... | 35 | 40 in one..... | 40 |
| Wisconsin | 3 | 25 to 50 in one; 25 to 60 in one; 30 to 50 in one. | 40 | 33½ in one; 40 in one; 43 in one. | 36 |
| General average... | | 35 cords per pit. | | 31 cords per pit. | |

(9.) *Charcoal burned in Meilers; weight of Oal.*

| States. | Weight per bushel. |
|-----------------------|--|
| Alabama | 18 pounds in one; 20 to 23 in one. |
| Connecticut | 20 pounds in two. |
| Georgia | 18 pounds in one; 18 to 21 in one. |
| Kentucky | 20 pounds in one; 25 pounds in one; 28 pounds in one. |
| Maine | 18 to 20 pounds in one. |
| Maryland | 15 pounds in one; 15 to 18 in one; 18 to 22 in one; 19 in one; 20 in one. |
| Massachusetts | 20 pounds in one. |
| Michigan | 16 to 20 pounds in one; 20 to 22 in one; 21 in one; 22 in one. |
| Minnesota | 20 pounds in one. |
| Missouri | 20 pounds in one; 22 in two. |
| New Jersey | 18 pounds in one. |
| New York | 15 to 22 pounds in one; 18 in one; 20 in one. |
| Ohio | 20 to 25 pounds in one; 22 in one; 22 to 24 in one; 23 in one; 24 in one 25 in one; 30 in one; 39 in one. |
| Oregon | 20 pounds in one. |
| Pennsylvania | 16½ pounds in one; 15 to 22½ in one; 17 to 24 in one; 20 in ten; 22½ in one; 23 in one. |
| Tennessee | 20 to 25 pounds in one; 22 in one. |
| Virginia | 18 pounds in one; 18 to 20 in one; 18 to 22 in one; 20 in six; 20 to 22 in one. |
| Vermont | 22 pounds in one. |
| West Virginia | 18 pounds in one. |
| Wisconsin | 22 pounds in two; 24 in one. |
| General average | About 19½ bushels. |

Range of Yield.

From various causes, depending upon the age and condition of the wood, the state of the weather, and the care given to attendance. In some instances it might amount to 20 per cent. In one instance a difference of 3 to 5 bushels was noticed, where neglected at night, and 2 to 3 pounds to the bushel in weight, if too much water was allowed in drawing.

An exposure to high winds and to storms during the burning will cause a perceptible difference. The state of the barometer has also been noticed to cause a perceptible difference in the burning of charcoal.

(10.) *Charcoal burned in Meilers; daily Wages paid.*

| States. | For cutting. | For teaming. | For burning. |
|---------------------|---|---|---|
| Alabama | 50 cents per cord in one; \$1 per day in one; \$1 to \$2 in one. | \$1 per day in one; \$1.20 in one; \$1 to \$1.30 in one. | \$1 to \$2 per day in one; \$1.25 in one; \$2 in one. |
| Connecticut | \$1 in one; \$1.25 in one | \$1.25 in two | \$1.50 in one; 50 cents per cord in one. |
| Georgia | \$1 per day in one; 50 cents per cord in one. | \$1 per day in two | \$1 in one; \$2 in one. |
| Kentucky | 35 cents per cord in one; 35 to 40 cents in one; 75 to 90 cents per day in one; \$1 to \$1.50 per day in one. | \$1.10 per day in one; \$1.25 in two; \$1 to \$1.25 in one. | \$1.25 per day in one; \$1 to \$1.25 in one; \$1.50 in one; \$26 to \$35 per month in one. |
| Maine | \$1.30 per day in one | \$1.30 per day in one | \$1.50 per day in one. |
| Maryland | \$1.25 to 1.50 per day in one; \$2 to \$2.50 in one; 40 cents per cord in one; 50 cents per cord in one. | 90 cents per day in one; \$1 in three. | 80 to 90 cents per day in one; \$1 in two; \$2 in one. |
| Massachusetts | \$1.50 per day in one | \$3.50 per day in one | \$2 per day in one. |
| Michigan | \$1.40 per day in one; \$1.50 in two; 60 cents per cord in one; 75 cents in two. | \$1.50 per day in one; \$1.55 in one; \$1.75 in one; \$3 in two. | \$1.40 per day in one; \$1.50 in one; \$1.75 in two; \$2.50 in one. |
| Minnesota | \$1.50 per day in one | \$3.50 per day in one | \$2 per day in one. |
| Missouri | \$1 per day in one; \$1.25 in one; 50 cents per cord in one. | \$1.25 per day in one. | \$1.25 per day in one; \$1.37 in one. |
| New Jersey | \$1.25 per day in one | \$1.25 per day in one | \$1.50 per day in one. |
| New York | \$1.20 to \$1.50 per day in one; \$1.50 in one; 60 cents per cord in one. | \$1.25 per day in one; \$1.20 to \$1.25 in one; \$2.50 to \$3 in one. | \$1.25 per day in one; \$2 in one. |

(10.) *Charcoal burned in Meilers, &c.*—Continued.

| States. | For cutting. | For teaming. | For burning. |
|---------------------|---|--|--|
| Ohio | \$1 per day in one; \$1 to \$1.25 in two; \$1 to \$1.50 in three; 80 cents in one; 25 cents per cord in one. | \$1.25 per day in three; \$1 to \$1.25 in one; \$1.25 to \$1.35 in one; \$1.25 to \$1.40 in one; \$1.40 to \$1.50 in one; \$3.50 in one. | \$1.25 per day in three; \$1.37½ in one; \$1 to \$1.25 in one; \$1 to \$1.35 in one; \$1.50 in two; \$1.50 to \$2 in one. |
| Oregon | \$1.75 per day in one. | \$3.50 per day in one. | |
| Pennsylvania | \$1 per day in six; \$1.10 in one; \$1 to \$1.20 in one; \$1 to \$1.25 in two; 35 cents per cord in one; 50 cents in one. | 90 cents per day in one; \$1 in six; \$1.08 in one; \$2 in one; \$4.50 in one. | \$1 per day in one; \$1 to \$1.25 in one; \$1.25 in one; \$1.40 in one; \$1.50 in two; \$2.50 to \$3 in one; 40 cents per cord in two. |
| Tennessee | 70 cents per day in one; 80 cents in one; \$1 in one; 50 cents per cord in one. | 50 cents per day in one; 70 cents in one; \$1 in three. | 75 cents per day in one; \$1 in three; \$1.25 in one. |
| Virginia | 75 cents to \$1 per day in one; 90 cents to \$1 in one; \$1 in four; 80 cents to \$1.20 in one; 40 cents per cord in two; 45 to 55 cents per cord in one. | 60 to 90 cents per day in one; 80 cents in one; 75 cents to \$1 in one; 75 cents to \$1 in one; 85 cents in three; 90 cents to \$1 in one; \$1 in one. | 75 cents to \$1 per day in one; \$1 in one; \$1 to \$1.50 in one; \$1.25 in one; 1.25 to \$1.50 in one; \$1.25 to \$1.75 in two. |
| Vermont | \$1 to \$1.50 per day in one. | \$1.25 per day in one. | \$1.25 per day in one. |
| West Virginia | 50 cents per cord in one. | | |
| Wisconsin | \$1.25 per day in one; \$1.50 in one; 75 cents per cord in one. | \$1.25 per day in two; \$2.50 in one. | \$1.40 per day in one; \$1.50 in one. |

VI.—STATISTICS OF FOREST PRODUCTS USED AS TANNING MATERIALS.

(a.) *General statement.*

With the view of obtaining facts and estimates with regard to the amount of bark used for tanning purposes in the country, its prices, and the probable duration of its supply, a circular was issued from the Department of Agriculture about the middle of July, 1881, to the principal tanneries in the United States, making a series of inquiries upon specific points in regard to these subjects.

Returns were received from 780 of these establishments, and the principal facts that they embrace are shown in the following tables. As the Department had no authority to require answers to its inquiries, nor any certain means of knowing the proper address of all of these establishments, these results are presented, not as claiming to be complete for the whole country, but as showing the individual experience of a large number of these establishments, and the opinions and suggestions of their owners or managers, upon the subject to which they relate. After giving a statement of each separate return, we shall present such generalizations as the subject appears to allow.

The intimate relation that exists between the tanning interests of the country and the general subject of forest conservation and of future supplies, render this a most important branch of inquiry. With slight exceptions our tanning materials have hitherto been supplied by the barks of our native trees, chiefly by the hemlock and the black and red oaks. It is necessary to destroy the trees in procuring the bark; and in older countries, where proper attention is given to the subject, care is taken to provide for a new growth for a future supply. Not only has this been hitherto wholly neglected in this country, but the timber itself, from which the bark has been peeled, has often been, and in some regions is still, left to rot on the ground. The extent of former and present waste from this practice, the probabilities of duration of present supplies, the amount of consumption, and suggestions concerning the future will be found in detail in the following pages. It has not been

thought proper to give the names of tanners or of tanneries, but the arrangement by States and counties will afford with sufficient exactness the means for locating the information and for comparing the results.

It will be seen that opinion very generally leads to the conclusion that our native bark has in very many cases been nearly exhausted, and that but few manufacturers can look hopefully forward many years for abundant supplies. Many are hoping for some discovery that will afford a substitute for the tanning materials now in use, and a very few suggest the only reasonable relief—from planting groves of oak to furnish bark for tanning purposes when grown to proper size. In a former report¹ we have given an account of the methods employed in other countries for the growth of oak in coppices for the supply of bark for tanning and of wood for fuel and charcoal. In regions favorable for the growth of the black and red oaks it would undoubtedly be a profitable investment to start plantations for this object, with a reasonable prospect of remunerative returns. In twenty or twenty-five years the trees would be large enough for peeling; and, if properly managed, the tract might be cut off periodically at these intervals for an indefinite period of time.

¹Report on Forestry, 1877, p. 146.

(1.) ALABAMA.

| Number. | Counties. | Kinds of bark used. | Quantities used. | | Yield of bark per acre. |
|---------|------------------|--|-----------------------------|-------------------|-------------------------|
| | | | 1880. | 1881 (estimated). | |
| 1 | Barbour | Red oak | 150 cords..... | 130 cords..... | |
| 2 | Bullock | White, black, red, Spanish, and water oak. | 30 to 40 cords .. | 30 to 40 cords .. | |
| 3 | Calhoun | White, chestnut, and mountain oak. | 20 cords..... | 20 cords..... | 3 cords..... |
| 4 | Cherokee | Black and chestnut oak..... | | | |
| 5 | ...do | Chestnut, black, and red oak. | 50 cords..... | 50 cords..... | 2 to 5 cords .. |
| 6 | ...do | Mountain or chestnut oak. | 100 cords..... | 150 cords..... | 4 to 15 cords .. |
| 7 | Cleburne | Mountain, black, and red oak. | 75 cords..... | | 5 cords..... |
| 8 | De Kalb | Chestnut oak | 1 ton ¹ | 1 ton | 10 cords..... |
| 9 | ...do | ...do | 35 to 40 cords .. | | 2 cords..... |
| 10 | Elmore | Red, white, and water oak. | 30 cords..... | 25 cords..... | $\frac{1}{2}$ cord..... |
| 11 | Greene | Black and red oak | 100 cords..... | 100 cords..... | 2 cords..... |
| 12 | Jackson | Chestnut oak | 6 cords..... | 4 cords..... | 16 cords..... |
| 13 | ...do | Black and chestnut oak..... | 10 cords..... | 15 cords..... | 5 cords..... |
| 14 | Jefferson | Black and mountain oak .. | 100 cords..... | | |
| 15 | Madison | Chestnut oak | 12 cords..... | | |
| 16 | Pickens | Black and white oak..... | 20 cords..... | 20 cords..... | |
| 17 | Randolph | Black oak..... | 70 cords..... | 80 cords..... | 5 cords..... |
| 18 | Saint Clair..... | Black and chestnut oak..... | 20 cords..... | 20 cords..... | 50 cords..... |
| 19 | Shelby | Chestnut, red, and black oak. | 20 cords ² | | 3 to 10 cords .. |
| 20 | ...do | ...do | 100 cords..... | | 5 cords..... |
| 21 | Talladega..... | Chestnut, mountain, and black oak. | 200 cords..... | 200 cords..... | |
| 22 | Tuscaloosa | ...do | 20 cords..... | 20 cords..... | |
| 23 | Wilcox | Black and red oak | 35 cords..... | 35 cords..... | |
| 24 | ...do | Red, black and Spanish oak. | 25 cords..... | 25 cords..... | 3 to 10 cords .. |

(2.) ARKANSAS.

| | | | | | |
|---|-----------------|------------------------------|---------------|---------------------|-----------------|
| 1 | Crawford | Black and white oak..... | 25 cords..... | | 20 cords |
| 2 | Pulaski | White oak | 50 cords..... | 300 to 400 cords .. | |
| 3 | Sebastian | Oak..... | | 300 cords..... | 1 to 5 cords .. |
| 4 | Sevier | Black, red, and white oak .. | 40 cords..... | 40 cords..... | 5 cords..... |

¹Specified as 2,000 pounds.²Specified as 2,500 pounds.

(3.) CALIFORNIA.

| | | | | | |
|----|------------------|------------------------------|--------------------------------|------------------|------------------|
| 1 | Alameda | Oak | 1,000 cords ¹ | 1,000 cords..... | 1 to 100 cords.. |
| 2 | Humboldt | ...do | 100 cords..... | 100 cords..... | 4 cords..... |
| 3 | Napa | Chestnut oak | 200 cords..... | 250 cords..... | 6 cords..... |
| 4 | San Diego | Live and chestnut oak..... | 100 cords..... | 100 cords..... | |
| 5 | Santa Clara..... | Chestnut oak | 1,000 cords..... | 1,200 cords..... | |
| 6 | Santa Cruz..... | ...do | 20 cords..... | 175 cords..... | |
| 7 | ...do | ...do | | 500 cords..... | |
| 8 | San Francisco. | Ground, live, and black oak. | 75 tons ² | 100 tons..... | |
| 9 | ...do | Oak..... | 125 cords..... | 125 cords..... | |
| 10 | ...do | ...do | 1,200 cords..... | 1,200 cords..... | 20 to 60 cords.. |
| 11 | Sonoma | ...do | 12 tons..... | 15 tons..... | |

¹Specified as 2,390 pounds.²Specified as 2,000 pounds.

(4.) CONNECTICUT.

| | | | | | |
|---|-----------------|-----------------------|-------------------------------|-----------------|------------------|
| 1 | Litchfield..... | Hemlock..... | 250 tons ¹ | 250 tons..... | 12 tons..... |
| 2 | ...do | ...do | 1,000 tons ¹ | 1,000 tons..... | 3 to 20 tons... |
| 3 | Windham | Oak and hemlock | 15 tons..... | 20 tons..... | |
| 4 | ...do | ...do | 250 cords..... | 300 cords..... | 8 to 10 cords... |

¹Specified as 2,000 pounds.

returns by States.

(1.) ALABAMA.

| Number. | Price of bark. | | | Estimated duration of bark supply. |
|---------|----------------------|--------------------------|-----------------------------|------------------------------------|
| | 1880. | 1881. | Range of prices since 1870. | |
| 1 | \$6.50 per cord..... | \$7.50 per cord..... | | Many years. |
| 2 | \$4 per cord..... | \$4 per cord..... | \$3 to \$4 per cord..... | |
| 3 | \$4.50 per cord..... | \$4.50 per cord..... | \$4.50 per cord..... | 100 years. |
| 4 | | | | Always. |
| 5 | \$3.75 per cord..... | \$3.75 per cord..... | \$3 to \$3.75 per cord..... | 15 to 20 years. |
| 6 | \$5 per cord..... | \$4 to \$5 per cord..... | \$4 to \$5 per cord..... | 25 years. |
| 7 | do..... | \$5 per cord..... | do..... | 100 years. |
| 8 | \$1 per cord..... | \$2 to \$4 per cord..... | \$1 per cord..... | 10 years. |
| 9 | \$5 per cord..... | \$6 per cord..... | \$3 to \$6 per cord..... | 4 to 5 years. |
| 10 | \$7 per cord..... | \$7 per cord..... | \$5 to \$7 per cord..... | 5 to 8 years. |
| 11 | \$4 per cord..... | \$4 per cord..... | \$4 per cord..... | 10 years. |
| 12 | \$2 per cord..... | \$2 per cord..... | \$1.75 to \$2 per cord..... | Always. |
| 13 | \$1 per cord..... | \$1 per cord..... | \$1 per cord..... | 50 years. |
| 14 | \$3 per cord..... | \$3 per cord..... | \$3 per cord..... | Always. |
| 15 | \$6 per cord..... | \$6 per cord..... | \$4.50 to \$6 per cord..... | 200 years. |
| 16 | \$5 per cord..... | \$5 per cord..... | \$5 per cord..... | 10 years. |
| 17 | \$4 per cord..... | \$4 per cord..... | \$4 per cord..... | 20 years. |
| 18 | \$5 per cord..... | \$5 per cord..... | \$3 to \$5 per cord..... | Do. |
| 19 | do..... | do..... | \$3.50 to \$5 per cord..... | 5 years. |
| 20 | \$5.50 per cord..... | | | About gone. |
| 21 | \$4.50 per cord..... | \$4.50 per cord..... | | 100 years. |
| 22 | \$5 per cord..... | \$5 per cord..... | \$5 to \$6 per cord..... | Many years. |
| 23 | \$5 per cord..... | \$4.50 per cord..... | \$4.50 to \$8 per cord..... | Always. |
| 24 | \$4 per cord..... | \$4.50 per cord..... | \$4 to \$5 per cord..... | 100 years. |

(2.) ARKANSAS.

| | | | | |
|---|----------------------|----------------------|--|------------|
| 1 | \$3 per cord..... | \$3 per cord..... | | 10 years. |
| 2 | \$4 per ton..... | \$4 per ton..... | | |
| 3 | | \$6.50 per cord..... | | 100 years. |
| 4 | \$3.50 per cord..... | \$3.50 per cord..... | | 20 years. |

(3.) CALIFORNIA.

| | | | | |
|----|----------------------------|-------------------------------------|----------------------------|-----------------|
| 1 | \$14 to \$25 per cord... | \$16.50 to \$17 per cord.. | \$12.50 to \$25 per cord.. | 15 to 20 years. |
| 2 | \$12 per cord..... | \$12 per cord..... | \$12 per cord..... | 100 years. |
| 3 | \$14 per cord..... | \$16 per cord..... | \$12 to \$16 per cord..... | 6 years. |
| 4 | \$24 per cord..... | \$28 per cord..... | | |
| 5 | \$13 per cord..... | \$14 per cord..... | \$13 to \$16 per cord..... | 10 to 15 years. |
| 6 | \$12.50 per cord..... | \$13 per cord..... | \$10 to \$14 per cord..... | |
| 7 | \$13 to \$14 per cord..... | \$13 to \$14 per cord..... | \$10 to \$14 per cord..... | 5 to 10 years. |
| 8 | \$23 per cord..... | \$23 der cord..... | | 20 years. |
| 9 | \$16 per cord..... | \$14 per cord..... | \$14 to \$20 per cord..... | |
| 10 | \$20 per cord..... | \$17.50 per cord ¹ | \$12 to \$20 per cord..... | 30 years. |
| 11 | \$20 per cord..... | \$20 per cord..... | \$10 to \$20 per cord..... | 10 years. |

¹ 28,000 cords used in State in 1881.

(4.) CONNECTICUT.

| | | | | |
|---|---------------------|----------------------------|-----------------------------|-----------------|
| 1 | \$10 per ton..... | \$10 per ton..... | \$8 to \$12 per ton..... | 10 years. |
| 2 | \$10 per ton..... | \$8 per ton..... | \$8 to \$12 per ton..... | |
| 3 | \$5 per ton..... | \$5 to \$6.50 per ton..... | \$5 to \$8 per ton..... | |
| 4 | \$5.50 per ton..... | \$6 per cord..... | \$5.25 to \$6 per cord..... | 25 to 30 years. |

(5.) GEORGIA.

| Number. | Counties. | Kinds of bark used. | Quantities used. | | Yield of bark per acre. |
|---------|-----------------|---------------------------------------|----------------------|----------------------|-------------------------|
| | | | 1880. | 1881 (estimated). | |
| 1 | Chattooga | Mountain, red, and black oak. | 50 cords | 65 to 70 cords | 6 to 16 cords .. |
| 2 | do | Black and chestnut oak. | 50 cords | | 3 cords |
| 3 | Crawford | Rock, mountain, black, and white oak. | 80 cords | 80 cords | 2 to 5 cords .. |
| 4 | Floyd | Chestnut oak | 200 cords | 400 cords | |
| 5 | Green | Red, white, black, and Spanish oak. | 60 to 70 cords | 15 cords | 4 cords |
| 6 | Hall | do | 200 cords | 400 cords | 5 cords |
| 7 | Harris | Black, red, and mountain oak. | 60 cords | 70 cords | 4 to 5 cords .. |
| 8 | Henry | Black, red, and Spanish oak. | 70 cords | 50 cords | |
| 9 | Lincoln | Black, red, yellow, and Spanish oak. | 20 cords | 15 cords | 8 to 10 cords .. |
| 10 | Lumpkin | Black and mountain | 400 cords | 400 cords | |
| 11 | Monroe | Red and black oak | 100 cords | | About gone .. |
| 12 | Newton | Red, yellow, and black oak. | | | |
| 13 | Pickens | Chestnut, red, and black oak. | 4 cords | 4 cords | 5 cords |
| 14 | Spaulding | Red, black, Spanish, and white oak. | 200 cords | 200 cords | 3 cords |
| 15 | Troup | Chestnut and black oak | 200 cords | 200 cords | About gone .. |
| 16 | Upton | Black, white, and Spanish oak. | 75 cords | 75 cords | |
| 17 | Wilkes | All kinds of oak | 100 cords | 100 cords | 8 to 10 cords .. |

(6.) IDAHO.

| | | | | | |
|---|------------|-----------|----------------|----------------|-------|
| 1 | Lake | Red pine. | 30 cords | 50 cords | |
|---|------------|-----------|----------------|----------------|-------|

(7) ILLINOIS.

| | | | | | |
|---|--------------|---------------|-----------------------------|-------------------|-------|
| 1 | Grundy | Hemlock | 700 cords | 800 cords | |
| 2 | Lake | do | 1,300 cords | 2,000 cords | |
| 3 | Will | do | 900 cords | | |
| 4 | do | do | 90 cords ¹ | 90 cords | |

¹ Specified as 2,200 pounds.

INDIANA.

| | | | | | |
|----|------------------|-----------------------------------|-----------------------------|--------------------|-------------------|
| 1 | Bartholomew .. | Chestnut oak | 2,000 cords | 2,000 cords | 1½ to 2 cords .. |
| 2 | Boone | Oak | 100 cords | 75 to 100 cords .. | 40 to 50 cords .. |
| 3 | Clark | Chestnut oak | 200 cords | 225 cords | |
| 4 | Decatur | White oak | 100 cords | 100 cords | |
| 5 | Floyd | Chestnut oak | 1,000 cords | 1,000 cords | |
| 6 | Henry | White oak and extract .. | 30 cords | 30 cords | |
| 7 | Huntington | White oak | 40 cords | | 1 to 10 cords .. |
| 8 | Jackson | Chestnut oak | 150 cords | 200 cords | 10 to 50 cords .. |
| 9 | Jay | Hemlock and white oak .. | 100 cords | | |
| 10 | Jefferson | Chestnut oak | 900 cords | 900 cords | |
| 11 | do | do | 50 cords | 50 cords | |
| 12 | Johnson | Chestnut, white, and black oak. | | | |
| 13 | Ripley | White oak | 20 cords | 15 cords | |
| 14 | Madison | Hemlock, chestnut, and white oak. | 100 cords | 100 cords | |
| 15 | Noble | Black and white oak | 75 cords | 50 to 75 cords .. | |
| 16 | Perry | Chestnut oak | 10 cords | 10 cords | 50 to 20 cords .. |
| 17 | do | do | 45 cords | 50 cords | 5 cords |
| 18 | do | Black and chestnut oak .. | | | |
| 19 | Shelby | Chestnut and chestnut extract. | 40 cords | 40 cords | |
| 20 | Vanderburg .. | Chestnut oak | 300 tons ¹ | 300 tons | |

¹ Specified as 2,000 pounds.

returns by States.

(5.) GEORGIA.

| Number. | Price of bark. | | | Estimated duration of bark supply. |
|---------|----------------------------------|----------------------------------|-------------------------------------|------------------------------------|
| | 1880. | 1881. | Range of prices since 1870. | |
| 1 | \$2.50 to \$4 per cord . . . | | | 100 to 200 years. |
| 2 | \$4 per cord | \$4 per cord | \$3 to \$4 per cord | 50 years. |
| 3 | \$5 per cord | \$5.50 to \$6 per cord | | 15 to 20 years. |
| 4 | \$5 per cord | \$5 per cord | \$5 per cord | 10 to 12 years. |
| 5 | \$5 per cord | \$4.50 per cord | \$4.50 to \$7.50 per cord | 3 to 4 years. |
| 6 | \$3.75 per cord | \$1.25 per cord | \$3.25 to \$4.25 per cord | 25 years. |
| 7 | \$6 per cord | \$6 per cord | \$6 to \$7 per cord | |
| 8 | \$5 per cord | \$5 per cord | \$5 to \$6.50 per cord | 25 years. |
| 9 | \$5 per cord | \$5 per cord | \$5 per cord | |
| 10 | \$2 to \$2.50 per cord | \$2 to \$2.50 per cord | \$2 to \$2.50 per cord | Always. |
| 11 | \$5 per cord | \$5 per cord | \$5 to \$7 per cord | Exhausted. |
| 12 | \$6 per cord | \$6 per cord | \$5 to \$7 per cord | About exhausted. |
| 13 | \$3.25 per cord | \$3.28 per cord | \$3 to \$3.50 per cord | Always. |
| 14 | \$5 per cord | \$5 per cord | \$5 to \$7 per cord | Do. |
| 15 | \$6.50 per cord | \$6.50 per cord | \$4 to \$6.50 per cord | 10 years. |
| 16 | \$5 per cord | | | 25 to 50 years. |
| 17 | \$5 per cord | \$5 per cord | \$5 to \$7 per cord | 15 to 20 years. |

(6.) IDAHO.

| | | | | |
|---|-------------------------|------------------------|--------------------------------|---------------|
| 1 | \$10 per cord | \$3 per cord | \$8 to \$15 per cord | Indefinitely. |
|---|-------------------------|------------------------|--------------------------------|---------------|

(7.) ILLINOIS.

| | | | | |
|---|---------------------------|----------------------------|-------------------------------------|--|
| 1 | \$10 per cord | \$11 per cord | \$8.75 to \$11 per cord | |
| 2 | \$7 per cord | \$9.50 per cord | \$6 to \$9.50 per cord | |
| 3 | \$8.75 per cord | \$9.50 per cord | \$7.75 to \$9.50 per cord | |
| 4 | \$9.50 per cord | \$10.50 per cord | | |

(8.) INDIANA.

| | | | | |
|----|---------------------------|---------------------------------|-------------------------------------|-----------------|
| 1 | \$10 per cord | \$12 per cord | \$8 to \$12 per cord | 5 years. |
| 2 | \$5 per cord | \$5 per cord | \$2.50 to \$5 per cord | 5 to 10 years. |
| 3 | \$8 per cord | \$7 per cord | \$6 to \$8 per cord | 8 to 10 years. |
| 4 | \$5.50 per cord | \$5.50 per cord | \$5 to \$5.50 per cord | 10 years. |
| 5 | \$13 per cord | | \$9 to \$13 per cord | |
| 6 | \$4 per cord | \$4.50 per cord | | |
| 7 | \$4 per cord | \$4 per cord | \$4 to \$5 per cord | 5 to 10 years. |
| 8 | \$9 per cord | \$10.50 per cord | \$8 to \$10.50 per cord | 25 years. |
| 9 | \$7.75 per cord | \$11 per cord | | All gone. |
| 10 | \$16 per cord | \$15 to \$20 per cord | 13.25 to \$22.50 per cord | Do. |
| 11 | \$19 per cord | \$19 per cord | | Do. |
| 12 | | | | About gone. |
| 13 | \$4 per cord | \$4 per cord | \$3 to \$5 per cord | 10 years. |
| 14 | \$10 per cord | \$12 per cord | \$8 to \$12 per cord | 10 years. |
| 15 | \$5 per cord | \$5 per cord | | 1 to 2 years |
| 16 | \$4 per cord | \$4 per cord | \$4 per cord | 100 years. |
| 17 | \$6 per cord | \$6 per cord | \$5 to \$7 per cord | 25 to 30 years. |
| 18 | 10 per cord | \$10 per cord | \$10 per cord | |
| 19 | 12 per cord | \$13 per cord | \$8 to \$13 per cord | |
| 20 | 10 per cord | \$10 per ton | \$7 to \$10 per ton | 25 years. |

(8.) INDIANA.

| Number. | Counties. | Kinds of bark used. | Quantities used. | | Yield of bark per acre. |
|---------|------------------|---------------------------|-------------------|-------------------|-------------------------|
| | | | 1880. | 1881 (estimated). | |
| 21 | Wabash | White oak | 100 cords | 100 cords | |
| 22 | Warren | White and black oak | | | 3 to 5 cords |
| 23 | Washington | Chestnut oak | 350 tons | 375 tons | 3 tons |
| 24 | Wayne | do | 1,000 cords | 1,200 cords | |
| 25 | Wells | White oak | 60 cords | 40 cords | 20 cords |

(9.) KENTUCKY.

| | | | | | |
|----|------------------|--------------------------------------|------------------------------|-------------------|---------------------------|
| 1 | Adair | Chestnut oak and ash | 65 cords | 90 cords | 1 cord |
| 2 | Barren | Black oak | 200 cords | 200 cords | 5 cords |
| 3 | Kenton | Chestnut oak | 800 cords ^a | 1,000 cords | |
| 4 | Lewis | do | | 35 cords | 10 cords |
| 5 | Lincoln | do | 20 cords | 20 cords | 5 cords |
| 6 | do | Chestnut and black oak | 190 cords | 100 cords | 2 cords |
| 7 | Madison | Chestnut oak | 175 cords | 500 cords | 2 cords |
| 8 | Marshall | Black oak | 35 cords | 50 cords | |
| 9 | Monroe | Black, white, and chestnut oak | 50 cords | 40 cords | 50 cords |
| 10 | Montgomery | Chestnut oak | 200 cords | 175 cords | $\frac{3}{20}$ cord |
| 11 | Wayne | do | | | 5 cords |

^aSpecified as 160 feet.

(10.) MAINE.

| | | | | | |
|----|------------------|---------------|-----------------------|----------------------|---------------------|
| 1 | Aroostook | Hemlock | 5,000 cords | 5,000 cords | 3 cords |
| 2 | do | do | None | 20 cords | 2 cords |
| 3 | Cumberland | do | 800 cords | 900 cords | 2 cords |
| 4 | do | do | 150 cords | 150 cords | |
| 5 | do | do | 2,500 cords | 2,500 cords | |
| 6 | Franklin | do | *500 cords | 500 cords | |
| 7 | do | do | 200 cords | 200 cords | |
| 8 | Hancock | do | 1,000 cords | 1,500 cords | |
| 9 | do | do | 900 cords | 700 cords | 5 to 15 cords |
| 10 | do | do | 2,500 cords | 2,600 cords | 5 cords |
| 11 | Kennebec | do | 500 cords | 600 cords | 6 cords |
| 12 | do | do | 100 cords | 50 cords | 2 cords |
| 13 | Lincoln | do | 10 cords | 10 cords | |
| 14 | do | do | 10 to 15 cords | 15 to 20 cords | |
| 15 | Oxford | do | 10 cords | 10 cords | |
| 16 | do | do | 75 cords | 50 cords | 2 cords |
| 17 | Penobscot | do | 2,000 cords | 2,000 cords | 1 cord |
| 18 | do | do | 3,100 cords | 3,800 | 2-5 cords |
| 19 | do | do | 9,000 cords | 12,000 cords | 1½ cords |
| 20 | do | do | None | None | 16 cords |
| 21 | do | do | 7,200 cords | 7,200 cords | 1½ cords |
| 22 | Somerset | do | 1,700 cords | 1,500 cords | 3 cords |
| 23 | do | do | *300 cords | 300 cords | |
| 24 | do | do | 200 cords | 200 cords | |
| 25 | Waldo | do | 150 cords | 150 cords | |
| 26 | do | do | | | |
| 27 | Washington | do | 6,000 cords | 8,000 cords | 1½ cords |
| 28 | do | do | 10,000 cords | 15,000 cords | 1 cord |
| 29 | do | do | 9,000 cords | 12,000 cords | 1½ cords |
| 30 | York | do | 100 cords | 100 cords | |
| 31 | do | do | *450 cords | 450 cords | |
| 32 | do | do | 75 to 100 cords | 100 cords | |

^aSpecified as 2,000 pounds.^bSpecified as 2,500 pounds.

returns by States—Continued.

INDIANA.

| Number. | Price of bark. | | | Estimated duration of bark supply. |
|---------|-----------------------|-----------------------|------------------------------|------------------------------------|
| | 1880. | 1881. | Range of prices since 1870. | |
| 21 | \$4.50 per cord | \$4.50 per cord | | 5 to 6 years. |
| 22 | \$4 per cord | \$5 per cord | \$4 to \$5 per cord | |
| 23 | \$6 per ton | \$7 per ton | \$6 to \$7 per ton | 10 years. |
| 24 | \$10 per cord | \$15 per cord | \$10 to \$15 per cord | |
| 25 | \$5 per cord | \$5 per cord | \$4.75 to \$5 per cord | 10 years. |

(9.) KENTUCKY.

| | | | | |
|----|-----------------------|-----------------------|------------------------------|-----------------|
| 1 | \$5 per cord | \$5.50 per cord | | 15 years. |
| 2 | \$4 per cord | \$4 per cord | \$4 per cord | 23 to 30 years. |
| 3 | \$18 per cord | \$15 per cord | \$10 to \$18 per cord | 10 to 20 years. |
| 4 | \$10 per cord | \$10 per cord | \$7 to \$12 per cord | |
| 5 | \$8 per cord | \$8 per cord | \$8 per cord | 5 years. |
| 6 | \$10 per cord | \$10 per cord | \$7 to \$10 per cord | 5 years. |
| 7 | \$6 per cord | \$6 per cord | \$6 per cord | 5 years. |
| 8 | \$2.25 per cord | \$2.50 per cord | \$2.25 to \$3 per cord | 10 years. |
| 9 | \$3 per cord | \$3 per cord | \$3 to \$5 per cord | 100 years. |
| 10 | \$6 per cord | \$6 per cord | \$5 to \$7 per cord | 10 years. |
| 11 | \$3.50 per cord | | \$3.50 to \$5 per cord | 50 years. |

(10.) MAINE.

| | | | | |
|----|------------------------|------------------------------|------------------------------|------------------------|
| 1 | \$4 per cord | \$4 per cord | \$4 per cord | 20 years. |
| 2 | \$3.50 per cord | \$4 per cord | \$3.50 to \$4 per cord | 50 years. |
| 3 | \$7 per cord | \$7 per cord | \$6 to \$8 per cord | 10 years. |
| 4 | \$9 per cord | \$9.50 per cord | | |
| 5 | \$10 per cord | | \$7 to \$11 per cord | |
| 6 | \$6 per cord | \$6 to \$7 per cord | \$5 to \$7.50 per cord | 25 years. |
| 7 | \$6 per cord | \$6 per cord | \$5 to \$8 per cord | |
| 8 | \$7.50 per cord | \$3 per cord | | |
| 9 | \$6 per cord | \$6 per cord | \$6 to \$7 per cord | 25 years. |
| 10 | \$5.50 per cord | \$6 per cord | \$5.50 to \$6 per cord | 5 years. |
| 11 | \$6 per cord | \$6 per cord | \$5 to \$7 per cord | 15 years. |
| 12 | \$5 per cord | \$5 per cord | \$5 to \$8 per cord | Always. |
| 13 | | | | |
| 14 | | | | |
| 15 | \$5 per cord | \$7 per cord | \$5 to \$7 per cord | |
| 16 | \$6 per cord | \$6 per cord | \$4 to \$6 per cord | 20 years. |
| 17 | \$6 per cord | \$6 per cord | \$5 to \$6 per cord | 10 years. |
| 18 | \$5.50 per cord | \$6 per cord | \$5 to \$6.50 per cord | 10 years. |
| 19 | \$5 per cord | \$5 per cord | \$3.50 to \$5 per cord | 20 years. |
| 20 | | | \$5 to \$6 per cord | 25 years. |
| 21 | \$6 per cord | \$6 per cord | \$4 to \$6 per cord | 10 to 15 years. |
| 22 | \$5 per cord | \$5 per cord | \$5 to \$7 per cord | 3 years. |
| 23 | \$5 per cord | \$5 per cord | \$5 to \$7 per cord | |
| 24 | \$5.50 per cord | \$5.50 per cord | \$5 to \$7 per cord | Many years. |
| 25 | \$6.50 per cord | \$6.75 per cord | \$6 to \$8 per cord | 15 to 20 years. |
| 26 | \$6 per cord | \$6 per cord | \$5.50 to \$8 per cord | Grows as fast as used. |
| 27 | \$5.37½ per cord | \$5.50 per cord | \$5 to \$5.50 per cord | 30 years. |
| 28 | \$4.50 per cord | \$4.50 to \$6 per cord | \$4.50 to \$6 per cord | 10 to 15 years. |
| 29 | \$6 per cord | \$6.50 per cord | | 40 years. |
| 30 | \$6 per cord | \$6 per cord | \$6 to \$7 per cord | All gone. |
| 31 | \$10 per cord | \$11 per cord | | |
| 32 | \$6 per cord | \$6 per cord | \$4 to \$6 per cord | 20 years. |

(11.) MARYLAND.

| Number. | Counties. | Kinds of bark used. | Quantities used. | | Yield of bark per acre. |
|---------|------------|--------------------------|-----------------------|-------------------|-------------------------|
| | | | 1880. | 1881 (estimated). | |
| 1 | Alleghany | Rock oak | 3,600 tons | 3,600 tons | 4 to 30 tons |
| 2 | Baltimore | Chestnut oak | 100 tons ^a | 125 tons | |
| 3 | Carroll | Chestnut and black oak | 300 tons ^b | 350 tons | 10 tons |
| 4 | do | do | 250 tons ^b | 300 tons | 8 to 10 tons |
| 5 | do | Chestnut and Spanish oak | 270 tons ^b | 350 tons | 6 tons |
| 6 | Frederick | Chestnut oak | 300 tons | 500 tons | 4 to 5 tons |
| 7 | do | Black and rock oak | 100 tons | | 8 to 20 tons |
| 8 | Washington | Black and rock oak | 100 tons | | 5 tons |

^a Specified as 2,240 pounds.^b Specified as 2,000 pounds.

(12.) MASSACHUSETTS.

| | | | | | |
|----|-----------|-----------------|--------------------------|-------------------|---------------|
| 1 | Berkshire | Hemlock | 600 tons ^a | 600 tons | 10 tons |
| 2 | do | do | 100 tons ^a | 100 tons | 10 tons |
| 3 | Bristol | do | 1,450 cords | 100 cords | |
| 4 | Essex | do | 240 cords | 50 cords | |
| 5 | do | do | 4,000 cords | 4,000 cords | |
| 6 | do | do | 1,200 cords | 1,000 cords | |
| 7 | do | do | 2,200 cords | 2,200 cords | |
| 8 | do | do | 1,241 cords | 1,850 cords | |
| 9 | do | do | 1,000 cords | 1,000 cords | |
| 10 | do | do | 2,000 cords | 2,000 cords | |
| 11 | do | do | 18 cords per week | 18 cords per week | |
| 12 | do | do | 400 cords | 600 cords | |
| 13 | do | do | None | 1,500 cords | |
| 14 | do | Sumac | 50 tons | 50 tons | |
| 15 | do | Hemlock | 1,200 cords | 1,200 cords | |
| 16 | Hampden | Hemlock and oak | 10 tons ^a | 10 tons | 8 to 10 tons |
| 17 | do | Hemlock | 650 tons ^a | 650 tons | |
| 18 | Hampshire | Oak and hemlock | 8 cords | 6 cords | |
| 19 | Middlesex | Hemlock | 3,500 cords ^b | 3,500 cords | |
| 20 | do | do | 1,500 cords | 1,500 cords | |
| 21 | do | do | 3,000 cords | 3,000 cords | |
| 22 | do | do | 3,000 cords | 3,000 cords | |
| 23 | Norfolk | do | 750 cords | 750 cords | |
| 24 | Suffolk | do | 800 cords | 800 cords | 8 cords |
| 25 | do | do | 3,500 cords | 3,500 cords | |
| 26 | Worcester | do | 900 cords | 1,000 cords | 3 to 20 cords |

^a Specified as 2,000 pounds.^b Specified as 2,240 pounds.

(13.) MICHIGAN.

| | | | | | |
|----|------------|----------------------------------|------------------------|-------------|----------------|
| 1 | Allegan | Hemlock | 100 cords | 100 cords | |
| 2 | do | do | 3,500 cords | 3,500 cords | 2 to 5 cords |
| 3 | Berrien | do | 180 cords | 130 cords | |
| 4 | Branch | White and yellow oak and hemlock | 150 cords | 275 cords | |
| 5 | Kalkaska | Hemlock | 100 cords | 150 cords | 10 to 40 cords |
| 6 | Leelenaw | do | 50 cords ^a | | 40 to 80 cords |
| 7 | Macomb | do | 80 cords | 100 cords | None here |
| 8 | Monroe | Hemlock and oak | 60 cords | 60 cords | do |
| 9 | Newaygo | Hemlock | 3,500 cords | 4,000 cords | 5 cords |
| 10 | Ottawa | do | 400 cords | 500 cords | 10 cords |
| 11 | St. Joseph | Yellow and white oak | 150 cords | 150 cords | |
| 12 | Van Buren | Hemlock | 700 cords | 800 cords | 3 cords |
| 13 | Wayne | Hemlock and oak | 540 cords | 540 cords | |
| 14 | do | Hemlock | 120 cords ^b | 120 cords | |
| 15 | do | Hemlock and sumac | 800 cords | | |
| 16 | do | Hemlock | 150 cords | 150 cords | |

^a Specified as 1,700 pounds.^b Specified as 2,000 pounds.

returns by States.

(11.) MARYLAND.

| Number. | Price of bark. | | | Estimated duration of bark supply. |
|---------|----------------------------|----------------------------|-----------------------------|------------------------------------|
| | 1880. | 1881. | Range of prices since 1870. | |
| 1 | \$7 per ton..... | \$7 per ton..... | \$6 to \$8.50 per ton..... | 10 years. |
| 2 | \$14 per ton..... | \$16 per ton..... | \$13.50 to \$20 per ton... | |
| 3 | \$5 and \$7 per ton..... | \$5 and \$9 per ton..... | \$5 and \$9 per ton..... | |
| 4 | \$5 and \$7 per ton..... | \$7 and \$9 per ton..... | \$6 and \$9 per ton..... | 25 years. |
| 5 | \$7 per ton..... | \$9 per ton..... | \$5.75 to \$19 per ton..... | 15 to 20 years. |
| 6 | \$9.50 to \$10 per ton.... | \$9.50 to \$10 per ton.... | \$7.50 to \$12 per ton..... | |
| 7 | \$7 per ton..... | \$7 per ton..... | \$7 to \$9 per ton..... | 50 years. |
| 8 | \$6 per ton..... | \$6.50 per ton..... | | 5 years. |

(12.) MASSACHUSETTS.

| | | | | |
|----|---------------------------|--------------------------|----------------------------|------------|
| 1 | \$8 per ton..... | \$7.50 per ton..... | \$7 to \$10 per ton..... | 20 years. |
| 2 | \$8 per ton..... | \$8 per ton..... | \$6 to \$10 per ton..... | 5 years. |
| 3 | \$11.50 per cord..... | \$13.50 per cord..... | | |
| 4 | \$10 per cord..... | \$11.50 per cord..... | \$9 to \$10.50 per cord.. | |
| 5 | \$11 per cord..... | \$11 per cord..... | | |
| 6 | \$10.50 per cord..... | \$11 per cord..... | \$8.75 to \$14 per cord.. | |
| 7 | \$11 per cord..... | \$11 per cord..... | \$8 to \$11 per cord..... | |
| 8 | \$10.25 per cord..... | \$11 per cord..... | | |
| 9 | \$11 per cord..... | \$11 per cord..... | | |
| 10 | \$12 per cord..... | \$11.50 per cord..... | | |
| 11 | \$11.50 per cord..... | \$11.50 per cord..... | | |
| 12 | \$12 per cord..... | \$11.50 per cord..... | | |
| 13 | | \$11 per cord..... | | |
| 14 | \$45 per cord..... | \$45 per cord..... | | |
| 15 | \$11 per cord..... | \$11 per cord..... | | |
| 16 | \$8 to \$10 per ton..... | \$8 to \$10 per ton..... | \$5 to \$10 per ton..... | Always. |
| 17 | \$8 per ton..... | \$8 per ton..... | \$7 to \$8 per ton..... | Few years. |
| 18 | \$4.50 per cord..... | \$4.50 per cord..... | \$4.50 to \$6 per cord.... | Always. |
| 19 | \$11.50 per cord..... | \$12.50 per cord..... | \$10 to \$12 per cord..... | |
| 20 | \$11 per cord..... | \$11.50 per cord..... | \$8 to \$12.50 per cord.. | |
| 21 | \$11 per cord..... | | | |
| 22 | \$10 per cord..... | \$11 per cord..... | \$8.50 to \$14 per cord.. | |
| 23 | \$12.50 per cord..... | \$12.50 per cord..... | \$12.50 per cord..... | |
| 24 | \$5.25 per cord..... | \$6 per cord..... | \$4 to \$6 per cord..... | 15 years. |
| 25 | \$10 to \$11 per cord.... | \$12.50 per cord..... | | |
| 26 | \$9.25 per cord..... | \$9 per cord..... | \$9 to \$11 per cord..... | 10 years. |

(13.) MICHIGAN.

(Table continued).

| | | | | |
|----|--------------------------|--------------------------|----------------------------|-------------|
| 1 | \$6 per cord..... | \$6 per cord..... | \$4.50 to \$6 per cord.... | 5 years |
| 2 | \$7 per cord..... | \$8 per cord..... | \$5 to \$8 per cord..... | About gone. |
| 3 | \$6 per cord..... | \$7 per cord..... | \$4 to \$7 per cord..... | |
| 4 | \$8 per cord..... | \$8.50 per cord..... | \$8 to \$8.50 per cord.... | 20 years. |
| 5 | \$2.25 per cord..... | \$2.25 per cord..... | | Always. |
| 6 | \$4.50 per cord..... | \$5 per cord..... | \$3 to \$5 per cord..... | 4 years. |
| 7 | \$7 per cord..... | \$7.50 per cord..... | \$6.50 to \$7.50 per cord | |
| 8 | \$6 per cord..... | \$6.50 per cord..... | | |
| 9 | \$4 per cord..... | \$5 per cord..... | \$2.50 to \$5 per cord... | 10 years. |
| 10 | \$4.50 per cord..... | \$5.25 per cord..... | \$3 to \$5.25 per cord.... | 10 years. |
| 11 | \$4 per cord..... | \$4.50 per cord..... | \$3 to \$4.50 per cord.... | 10 years. |
| 12 | \$5.50 per cord..... | \$6.50 per cord..... | \$4 to \$6.50 per cord.... | 10 years. |
| 13 | \$7 per cord..... | \$7 per cord..... | \$5.50 to \$7 per cord.... | 10 years. |
| 14 | \$6.50 per cord..... | \$7 per cord..... | \$6.50 to \$7 per cord.... | |
| 15 | \$6 per cord..... | \$6.25 per cord..... | \$5.50 to \$8.75 per cord. | |
| 16 | \$7 to 7.50 per cord.... | \$7 to 7.50 per cord.... | | |

(13) MISSISSIPPI.

| Number. | Counties. | Kinds of bark used. | Quantities used. | | Yield of bark per acre. |
|---------|------------------|-------------------------------------|------------------|-------------------|-------------------------|
| | | | 1880. | 1881 (estimated). | |
| 1 | Clark | Red oak | 250 cords | 250 cords | |
| 2 | Jackson | do | 100 cords | 100 cords | |
| 3 | Kemper | Black, red, white, and Spanish oak. | 50 cords | 50 cords | |
| 4 | Lauderdale | Black, red, and white oak .. | 75 cords | | 2 to 8 cords |
| 5 | Monroe | Red and black oak | 200 cords | 200 cords | 8 cords |
| 6 | Oktibbeha | Red and white oak | 18 cords | | 2½ cords |
| 7 | Pike | Red oak | 300 cords | 400 cords | |

(14) MISSOURI.

| | | | | | |
|---|-------------------|-------------------------------------|----------------------------|--------------------------------|---------------|
| 1 | Cooper | Chestnut oak | 55 cords | 65 cords | |
| 2 | Girardeau | Black and white oak | 50 cords | 50 cords | 4 cords |
| 3 | Newton | White, black, red, and Spanish oak. | 14 cords | None | |
| 4 | Saint Louis | Sumac | 12 tons ¹ | 12 tons | |
| 5 | do | Chestnut and hemlock | 190 tons | 125 tons | |
| 6 | do | Chestnut oak | 1,000 cords | 1,000 cords ² | |
| 7 | do | do | 1,000 cords | 1,200 cords | |

¹ Specified as 2,240 pounds.

(15) NEW HAMPSHIRE.

| | | | | | |
|----|-----------------|---------------|-------------------------------|-------------------|-----------------|
| 1 | Carroll | Hemlock | 40 cords | 40 to 50 cords .. | |
| 2 | do | do | 1,200 tons ¹ | 1,200 tons | 25 cords |
| 3 | do | do | | | |
| 4 | Cheshire | do | 200 cords | | |
| 5 | Coos | do | 20 cords | 20 cords | |
| 6 | Grafton | do | 400 cords | 400 cords | |
| 7 | do | do | 350 cords | 350 cords | |
| 8 | do | do | 1,000 cords | 800 cords | |
| 9 | do | do | 150 cords | 150 cords | |
| 10 | Hillsboro | do | 250 cords | 250 cords | |
| 11 | do | do | 75 cords | 10 cords | |
| 12 | Merrimac | do | 2,500 cords | 2,500 cords | 4 cords |
| 13 | do | do | 250 cords | 275 cords | 3 to 5 cords .. |
| 14 | Stafford | do | 1,500 cords | 1,500 cords | |

¹ Specified as 2,240 pounds.

(16) NEW JERSEY.

| | | | | | |
|----|---------------|------------------------------|-------------------------------|-------------------|-----------------|
| 1 | Cumberland .. | Red, black, and white oak .. | 250 cords | 250 cords | |
| 2 | Essex | Oak and hemlock | 1,250 tons ¹ | 1,500 tons | |
| 3 | do | do | 936 tons | 936 tons | None here |
| 4 | Gloucester .. | Oak | 125 tons ¹ | 90 to 100 tons .. | |
| 5 | Hunterdon .. | Red and rock oak | 75 cords | 75 cords | 5 cords |
| 6 | Salem | Red and black oak | 130 cords | 150 cords | 6 cords |
| 7 | Sussex | Oak and hemlock | 100 cords ¹ | 100 cords | |
| 8 | do | Oak | 100 cords | 100 cords | 8 cords |
| 9 | Warren | Oak and hemlock | 2,000 tons | 2,500 tons | 8 tons |
| 10 | do | Oak | 125 tons | 125 tons | 5 to 10 tons .. |
| 11 | do | Rock, red, and black oak .. | 100 cords | 100 cords | |

¹ Specified as 2,000 pounds.

returns by States.

(13) MISSISSIPPI.

| Number. | Price of bark. | | | Estimated duration of bark supply. |
|---------|---------------------------|---------------------------|------------------------------|------------------------------------|
| | 1880. | 1881. | Range of prices since 1870. | |
| 1 | \$4 to \$5 per cord | \$4 to \$5 per cord | \$4 to \$5 per cord | 10 to 15 years. |
| 2 | \$6.50 per cord | \$7.50 per cord | | 1 year. |
| 3 | \$5 per cord | \$5 per cord | \$5 per cord | |
| 4 | | | | |
| 5 | \$4.50 per cord | | \$4 to \$4.50 per cord | 20 to 40 years. |
| 6 | \$4 per cord | \$4 per cord | \$3.50 to \$6 per cord | |
| 7 | \$2.50 per cord | \$2.50 per cord | | |
| 8 | \$3 per cord | \$5 per cord | | |

(14) MISSOURI.

| | | | | |
|---|-----------------------------|--------------------------------|--------------------|----------------------|
| 1 | \$14.50 per cord | \$14.75 per cord | | 20 years. Always. |
| 2 | \$4 per cord | \$4 per cord | \$4 per cord | |
| 3 | | | | |
| 4 | | | | None here. |
| 5 | \$10 per ton | \$10 and \$12.50 per ton | | |
| 6 | \$10 to \$12 per cord | \$12.75 per cord | | |
| 7 | \$10 per cord | \$12 per cord | | |

²Specified as 2,000 pounds.

(15) NEW HAMPSHIRE.

| | | | | |
|----|---------------------------|---------------------------|------------------------------|-----------------|
| 1 | \$6.50 per cord | \$6.50 per cord | \$5 to \$6.50 per cord ... | Many years. |
| 2 | \$10 per ton | \$10 per ton | \$8 to \$10 per ton | |
| 3 | \$9 per cord | \$8 per cord | | |
| 4 | \$10 per cord | | | 100 years. |
| 5 | \$6 per cord | \$4 per cord | \$3 to \$6 per cord | |
| 6 | \$7 per cord | \$7 per cord | \$6 to \$9 per cord | |
| 7 | \$6.50 per cord | \$7.50 per cord | \$6 to \$7.50 per cord | |
| 8 | \$7.50 per cord | \$7.50 per cord | \$6 to \$9 per cord | 5 to 10 years. |
| 9 | \$6 per cord | \$7 per cord | \$5 to \$7 per cord | |
| 10 | \$8 per cord | \$8 per cord | \$5 to \$8 per cord | |
| 11 | \$8 per cord | \$7 per cord | \$7 to \$8 per cord | 15 years. |
| 12 | \$8.50 per cord | \$9 per cord | \$7 to \$12 per cord | 20 years. |
| 13 | \$8 per cord | \$7 to \$8 per cord | \$7 to \$10 per cord | 50 years. |
| 14 | \$8 to \$9 per cord | \$8 to \$9 per cord | \$7 to \$9 per cord | Few years. |
| | | | | 10 to 20 years. |
| | | | | About gone. |

(16) NEW JERSEY.

| | | | | |
|----|-------------------------------|-------------------------------|----------------------------|---|
| 1 | \$6 and \$10 per cord | \$6 and \$10 per cord | | 5 years. 25 years. 10 years. 15 to 20 years. 20 years. 10 years. |
| 2 | \$10 and \$14 per ton | \$10 and \$14 per ton | | |
| 3 | \$12 and \$14 per ton | \$12 and \$14 per ton | \$12 and \$14 per ton | |
| 4 | \$7.50 and \$13.50 per ton .. | \$7.50 and \$13.50 per ton .. | | |
| 5 | \$8 per cord | \$8 per cord | \$7 to \$8 per cord | |
| 6 | \$10 per cord | \$10 per cord | \$8 to \$10 per cord | |
| 7 | \$6.50 per cord | \$6.75 per cord | \$6 to \$7 per cord | |
| 8 | \$6.50 per cord | \$7.50 per cord | | |
| 9 | \$7 per ton | \$7 per ton | \$6 to \$9 per ton | |
| 10 | \$7 per ton | \$8 per ton | \$6 to \$10 per ton | |
| 11 | \$6 per cord | \$7 to \$8 per cord | \$6 to \$12 per cord | |
| | | | | |
| | | | | |
| | | | | |

(17) NEW YORK.

| Number. | Counties. | Kinds of bark used. | Quantities used. | | Yield of bark per acre. |
|---------|-------------|------------------------------|--------------------------|--------------------------|-------------------------|
| | | | 1880. | 1881 (estimated). | |
| 1 | Albany | Hemlock | 200 tons ¹ | 200 tons | 10 cords |
| 2 | Allegany | do | 8,000 tons | 7,000 tons | 10 tons |
| 3 | do | do | 250 cords | 100 cords | 10 cords |
| 4 | do | do | 75 cords | 150 cords | |
| 5 | do | do | 12,000 cords | 12,000 tons ¹ | 8 tons |
| 6 | Broome | do | 70 cords | | |
| 7 | do | do | 2,111 tons ¹ | 2,111 tons | 8 to 10 tons |
| 8 | do | Hemlock and oak | 530 tons ¹ | 500 tons | 10 tons |
| 9 | do | Hemlock | 6 cords ¹ | 7 cords | |
| 10 | do | do | 4,800 tons ¹ | 5,000 tons | 10 tons |
| 11 | do | do | 3,500 tons ¹ | 3,500 tons | 1 to 30 tons |
| 12 | do | do | 3,500 tons ¹ | 3,500 tons | 5 to 20 tons |
| 13 | Cattaraugus | do | | 300 to 400 cords | |
| 14 | do | do | 35 cords | 100 cords | |
| 15 | do | do | 3,500 cords ¹ | 3,500 cords | 8 to 10 cords |
| 16 | do | do | 6,300 cords | 6,000 cords | 18 to 20 cords |
| 17 | do | do | 2,500 cords ¹ | 3,000 cords | 25 cords |
| 18 | Cayuga | do | | | |
| 19 | do | do | | | |
| 20 | Chautauqua | do | | | |
| 21 | do | do | 1,600 cords | 2,000 cords | 20 cords |
| 22 | do | do | 25 cords | 30 cords | 50 cords |
| 23 | Chemung | Hemlock, white, and rock oak | 1,920 tons ¹ | 1,920 tons | 12 tons |
| 24 | do | Hemlock and oak | 2,200 tons ¹ | 2,200 tons | 8 tons |
| 25 | do | Hemlock | 600 tons ¹ | 600 tons | 5 to 12 tons |
| 26 | do | Oak and hemlock | 1,800 tons ¹ | 1,800 tons | |
| 27 | do | Hemlock | 2,000 tons ¹ | 2,000 tons | 8 to 10 tons |
| 28 | Chenango | do | 400 tons ¹ | | |
| 29 | do | do | 250 cords | 300 cords | |
| 30 | Clinton | do | 1,200 cords | 1,500 cords | 1 to 2 cords |
| 31 | do | do | 40 cords | 30 cords | |
| 32 | do | do | 150 cords | 150 cords | |
| 33 | do | do | 1,500 cords | 1,200 cords | Less than 5 cords |
| 34 | do | do | 600 cords | 600 cords | |
| 35 | Cortland | do | 100 cords | | |
| 36 | do | do | 2,800 cords | 4,000 cords | 6 cords |
| 37 | do | do | 250 cords | 250 cords | |
| 38 | Delaware | do | 150 tons ¹ | 150 tons | |
| 39 | do | do | 2,500 tons ¹ | 2,500 tons | 9 tons |
| 40 | do | do | 2,200 tons ¹ | 2,200 tons | 10 to 20 tons |
| 41 | do | do | 3,000 cords | 3,000 cords | 10 cords |
| 42 | do | do | 100 cords | | |
| 43 | do | do | 1,500 cords | 1,500 cords | 75 cords |
| 44 | do | do | 3,000 tons ¹ | 3,000 tons | 15 tons |
| 45 | Delaware | Hemlock | 25 cords ¹ | 25 to 50 cords | 50 cords |
| 46 | Duchess | Rock and red oak | 225 tons ¹ | 225 tons | |
| 47 | Erie | Hemlock | 200 cords | 200 cords | |
| 48 | do | do | 800 tons ¹ | 800 tons | |
| 49 | do | Hemlock and oak | 100 tons ¹ | 100 tons | |
| 50 | do | Hemlock | 50 cords | 75 cords | |
| 51 | do | do | 1,800 cords | 2,000 cords | |
| 52 | do | do | 1,400 cords ¹ | 1,500 cords | 2 to 20 cords |
| 53 | do | do | 6,000-7,000 cords | 7,000 to 8,000 c'ds. | |
| 54 | do | do | 6,000 cords | 6,000 cords | 10 cords |
| 55 | do | Extract of hemlock | 3,000 cords | 4,000 cords | 30 cords |
| 56 | do | Hemlock | 1 ton | 1 ton | |
| 57 | do | do | 2,000 cords ¹ | 2,000 cords | 10 to 12 cords |
| 58 | Essex | do | 50 cords ² | 60 cords | |
| 59 | Franklin | do | 3,600 cords | 3,600 cords | 2 cords |
| 60 | do | do | 600 cords | 600 cords | 3 to 5 cords |
| 61 | do | do | 150 cords | 150 cords | |
| 62 | do | do | 800 cords | 800 cords | 15 cords |
| 63 | do | do | 3,000 cords | 3,000 cords | 1½ to 2 cords |
| 64 | Fulton | do | 2,500 | 2,500 cords | 3 to 4 cords |
| 65 | Hamilton | do | 3,000 tons ¹ | 3,000 tons | 3 tons |
| 66 | do | do | 1,000 cords | 5,000 cords | 3 cords |
| 67 | Herkimer | Hemlock | 150 cords ¹ | 200 cords | 2 cords |
| 68 | do | do | 300 cords ¹ | 400 cords | |
| 69 | do | do | 250 cords | 250 cords | |

¹Specified as 2,000 pounds.²Specified as 2,240 pounds.

returns by States.

(17) NEW YORK.

| Number. | Price of bark. | | | Estimated duration of bark supply. |
|---------|-----------------------------|--------------------------------|--------------------------------|------------------------------------|
| | 1880. | 1881. | Range of prices since 1870. | |
| 1 | \$5 per ton..... | \$5 per ton..... | \$5 per cord..... | 10 years. |
| 2 | \$5 per ton..... | \$5 per ton..... | \$4 to \$5 per ton..... | 5 years. |
| 3 | \$5.50 per cord..... | \$5.50 per cord..... | \$4 to \$5.50 per cord..... | 5 years. |
| 4 | \$4.25 per cord..... | \$4.75 per cord..... | | 10 years. |
| 5 | \$4.50 per ton..... | \$5 per ton..... | \$4 to \$5 per ton..... | 8 to 12 years |
| 6 | \$4.75 per cord..... | \$5 per cord..... | \$4 to \$5 per ton..... | 4 years. |
| 7 | \$5.76 per ton..... | \$6.25 per ton..... | \$5 to \$6.25 per ton..... | 4 to 6 years. |
| 8 | \$5.25 per ton..... | \$5.25 per ton..... | \$5 to \$6 per ton..... | 30 years. |
| 9 | \$5 per cord..... | \$5.50 per cord..... | \$3.50 to \$5.50 per cord..... | Ten years. |
| 10 | \$6 per ton..... | \$7 per ton..... | \$6 per ton..... | Exhausted. |
| 11 | \$5 per ton..... | \$6 per ton..... | \$5 to \$6 per ton..... | 3 years. |
| 12 | \$5 per ton..... | \$5 per ton..... | \$4.50 to \$5 per ton..... | 2 years. |
| 13 | | \$4 per cord..... | \$3.50 to \$4 per cord..... | 20 years. |
| 14 | \$5 per cord..... | \$5 per cord..... | \$3.50 to \$5 per cord..... | 10 years. |
| 15 | \$4.25 per cord..... | \$4.50 per cord..... | \$4 to \$4.50 per cord..... | 15 years. |
| 16 | \$5.50 per cord..... | \$5.50 per cord..... | \$4 to \$5.50 per cord..... | 3 to 5 years. |
| 17 | \$5.50 per cord..... | \$6 per cord..... | \$4.25 to \$6 per cord..... | 15 years. |
| 18 | \$5 per cord..... | \$5 per cord..... | \$5 to \$6 per cord..... | 25 years. |
| 19 | \$7 per cord..... | \$7 per cord..... | \$7 to \$8 per cord..... | 10 to 15 years. |
| 20 | \$4.40 per cord..... | \$5.50 per cord..... | \$4.40 to \$5.50 per cord..... | |
| 21 | \$6 per cord..... | \$6 per cord..... | \$5 to \$6 per cord..... | 5 years. |
| 22 | \$4 per cord..... | \$5 per cord..... | \$3.50 to \$5..... | 25 to 30 years. |
| 23 | \$4.50 and \$5.50 per ton. | \$6 per ton..... | | 3 years. |
| 24 | \$5 per ton..... | \$6 per ton..... | \$4 to \$6 per ton..... | 5 years. |
| 25 | \$5.25 per ton..... | \$6.25 per ton..... | \$5 to \$6 per ton..... | 5 years. |
| 26 | \$5.25 per ton..... | \$5.50 per ton..... | \$4.50 to \$5.50 per ton..... | 20 years. |
| 27 | \$5.50 per ton..... | \$6.50 per ton..... | \$5 to \$6.50 per ton..... | 7 to 8 years. |
| 28 | \$4 per ton..... | \$6 per ton..... | \$3 to \$6 per ton..... | 10 years. |
| 29 | \$4.50 per cord..... | \$5.50 per cord..... | \$4 to \$5.50 per cord..... | 20 years. |
| 30 | \$5.25 per cord..... | \$5.50 per cord..... | \$4 to \$5.50 per cord..... | 2 to 3 years. |
| 31 | \$5.50 per cord..... | \$5.50 per cord..... | \$5.50 to \$6 per cord..... | 8 to 10 years. |
| 32 | \$7.50 per cord..... | \$7 per cord..... | \$6.50 to \$8 per cord..... | Many years. |
| 33 | \$6 per cord..... | \$6.50 per cord..... | \$5 to \$6.50 per cord..... | 3 to 5 years. |
| 34 | \$6 per cord..... | \$6.25 per cord..... | \$5 to \$6.25 per cord..... | 5 years. |
| 35 | \$5 per cord..... | \$5 to \$5.50 per cord..... | \$5 to \$5.50 per cord..... | 10 years. |
| 36 | \$6 to \$6.25 per cord..... | \$6.75 to \$7.25 per cord..... | \$5 to \$7.25 per cord..... | About gone. |
| 37 | \$5 per cord..... | \$5 per cord..... | \$5 per cord..... | 25 years. |
| 38 | \$5 per ton..... | \$5 per ton..... | \$4 to \$5 per ton..... | 10 years. |
| 39 | \$5 per ton..... | \$1 per ton..... | \$5 per ton..... | 5 years. |
| 40 | \$5.50 per ton..... | \$5.75 per ton..... | \$3.50 to \$5.75 per ton..... | 2 years. |
| 41 | \$6 per cord..... | \$7 per cord..... | \$5 to \$7 per cord..... | 2 years. |
| 42 | \$5 per cord..... | \$5 per cord..... | \$4 to \$5 per cord..... | 5 years. |
| 43 | \$4.50 per cord..... | \$4.50 per cord..... | \$4 to \$4.50 per cord..... | 2 years. |
| 44 | \$6 per ton..... | \$6.25 per ton..... | \$6 to \$6.25 per ton..... | 3 to 4 years. |
| 45 | \$3 per cord..... | \$3 per cord..... | \$3 to \$4 per cord..... | 50 years. |
| 46 | \$10 per ton..... | \$10 per ton..... | \$9 to \$13 per ton..... | Always. |
| 47 | \$4.50 per cord..... | \$5 per cord..... | \$4 to \$6 per cord..... | 20 years. |
| 48 | \$5.50 per ton..... | \$6 per ton..... | \$5 to \$6 per ton..... | 10 years. |
| 49 | \$5.25 per ton..... | \$5.50 per ton..... | \$4.50 to \$7 per ton..... | 10 years. |
| 50 | \$3.50 per cord..... | \$4.50 per cord..... | \$3 to \$4.50 per cord..... | 20 years. |
| 51 | \$6.50 per cord..... | \$7.50 per cord..... | | Ten years. |
| 52 | \$5 per ton..... | \$6.25 per ton..... | \$5 to \$7 per ton..... | 5 to 20 years. |
| 53 | \$6 per cord..... | \$6.75 per cord..... | \$5.50 to \$6.75 per cord..... | |
| 54 | \$6 per cord..... | \$6.50 per cord..... | \$5 to \$7 per cord..... | |
| 55 | \$6.50 per cord..... | \$6.50 per cord..... | \$4.50 to \$7 per cord..... | 10 years. |
| 56 | | | | |
| 57 | \$6 per cord..... | \$6.50 per cord..... | \$4 to \$8 per cord..... | 10 years. |
| 58 | \$4.50 per cord..... | \$4.50 per cord..... | \$4.50 to \$5 per cord..... | |
| 59 | | | | |
| 60 | \$5 per cord..... | \$6 per cord..... | \$4 to \$6 per cord..... | Ten years. |
| 61 | \$5 to \$6 per cord..... | \$5 to \$6 per cord..... | \$4 to \$6 per cord..... | 10 years. |
| 62 | \$5.25 per cord..... | \$6.25 per cord..... | \$4 to \$6.25 per cord..... | 10 years. |
| 63 | \$5.50 per cord..... | \$6 per cord..... | \$4.50 to \$6 per cord..... | 15 to 20 years. |
| 64 | \$3.75 per cord..... | \$4 to \$4.25 per cord..... | \$3.50 to \$5 per cord..... | 8 years. |
| 65 | \$4 per ton..... | \$4 per ton..... | \$3.50 to \$4 per ton..... | 15 years. |
| 66 | \$4 per cord..... | \$4 per cord..... | | 15 to 20 years. |
| 67 | \$5 per cord..... | \$7.50 per cord..... | Average \$5 per cord..... | 10 years. |
| 68 | \$6 per cord..... | \$7 per cord..... | | 5 to 10 years. |
| 69 | \$4 to \$4.50 per cord..... | \$4.50 to \$5 per cord..... | | 10 to 15 years. |

NEW YORK.

(Table continued.)

| Number. | Counties. | Kinds of bark used. | Quantities used. | | Yield of bark per acre. |
|---------|-----------------|------------------------|------------------------------------|-------------------------|-------------------------|
| | | | 1880. | 1881 (estimated). | |
| 70 | Jefferson | Hemlock and sumac | 316 tons hemlock and 3 tons sumac. | 600 tons | 3 to 5 tons |
| 71 | do | Hemlock | 550 cords | | 25 to 30 cords |
| 72 | do | do | 800 cords | 800 cords | 10 cords |
| 73 | do | do | 250 cords ¹ | 550 cords | |
| 74 | do | do | 300 cords ¹ | 300 cords | |
| 75 | do | do | 8,000 tons ¹ | 8,000 tons | 4 tons |
| 76 | do | do | 3,600 tons ¹ | 3,600 tons | 5 tons |
| 77 | do | do | 350 tons ¹ | 250 tons | |
| 78 | Lewis | do | 300 tons ¹ | 300 tons | |
| 79 | do | do | 4,200 tons ¹ | 4,000 tons | 4 to 5 tons |
| 80 | do | do | 4,500 tons ² | 5,000 tons | 3 to 5 tons |
| 81 | do | do | 12,000 tons ³ | 16,000 tons | 3 tons |
| 82 | do | do | 250 cords ¹ | | |
| 83 | Madison | do | 500 cords | 500 to 600 cords | 10 to 15 cords |
| 84 | do | do | 300 cords | 300 cords | |
| 85 | do | Hemlock and oak | 500 tons ¹ | 250 tons | |
| 86 | Montgomery | Hemlock | 400 cords | 400 cords | |
| 87 | do | do | 50 cords | 50 cords | 50 cords |
| 88 | Monroe | Hemlock | 300 cords ¹ | 300 cords | |
| 89 | do | do | | 2,500 cords | |
| 90 | Orange | Oak and hemlock | 200 tons ¹ | 300 tons | |
| 91 | Niagara | Hemlock | 6 cords per week. | 6 cords per week | |
| 92 | Oneida | do | 15 cords ² | 15 cords | 12 to 15 cords |
| 93 | do | do | 5,000 cords ² | 5,000 cords | 23 cords |
| 94 | do | do | 5,000 cords ¹ | 5,000 cords | 6 to 8 cords |
| 95 | do | do | 750 cords ² | 750 cords | |
| 96 | do | do | 900 cords ² | 1,000 cords | |
| 97 | Onondaga | Hemlock, oak and sumac | 50 cords ³ | 50 cords | |
| 98 | do | do | 20 to 30 cords | 20 to 30 cords | 20 to 30 cords |
| 99 | Orleans | Hemlock | 275 cords | 275 cords | |
| 100 | Oswego | do | 250 tons ¹ | 250 tons | |
| 101 | do | do | 2,000 cords | 500 cords | 10 cords |
| 102 | do | do | 3,800 cords ³ | 3,800 cords | 8 cords |
| 103 | do | do | 20,000 to 22,000 cords. | 22,000 cords | |
| 104 | do | do | 5,000 cords ³ | 5,000 cords | 5 to 6 cords |
| 105 | Otsego | do | 100 cords ¹ | 100 cords | |
| 106 | do | do | 350 cords ¹ | 400 cords | 50 cords |
| 107 | do | do | 300 cords | 300 cords | 25 to 30 cords |
| 108 | do | Hemlock and oak | 200 tons ¹ | 500 cords | |
| 109 | Rockland | Oak | 45 to 50 cords | | |
| 110 | Saint Lawrence. | Hemlock | 100 cords | 200 cords | 20 to 25 cords |
| 111 | do | do | 500 cords | 500 cords | |
| 112 | do | do | 400 tons | 400 tons | |
| 113 | do | do | 50 cords | 150 cords | 10 to 25 cords |
| 114 | Schuyler | Hemlock and oak | 300 tons ¹ | 300 tons | 10 to 15 tons |
| 115 | Steuben | Hemlock | 3,000 cords ² | 3,000 cords | 10 cords |
| 116 | do | do | | 2,500 tons ¹ | 10 tons |
| 117 | do | do | 3,300 tons ¹ | 3,800 tons | 8 to 12 tons |
| 118 | do | do | 1,500 tons ¹ | 1,500 tons | 6 tons |
| 119 | do | do | 60 cords | 50 cords | 45 cords |
| 120 | Sullivan | Oak and hemlock | 300 tons | 400 to 500 tons | |
| 121 | do | Hemlock | 2,500 cords | 2,500 cords | 8 cords |
| 122 | do | do | 4,000 cords | 4,000 cords | 4 cords |
| 123 | do | do | 2,000 cords | | 30 cords |
| 124 | Tioga | Hemlock | 6 tons ¹ | 6 tons | 6 tons |
| 125 | do | do | 750 tons ¹ | 1,100 tons | 12 tons |
| 126 | do | Hemlock and oak | 2,545 tons ¹ | 2,750 tons | 10 tons |
| 127 | Tompkins | do | 12,000 tons ¹ | 12,000 tons | 6 to 15 tons |
| 128 | do | Hemlock | 100 tons | | |
| 129 | do | do | 250 tons | 250 tons | |
| 130 | Ulster | do | 1,500 tons ¹ | 1,500 tons | 5 cords |
| 131 | Warren | Hemlock | 2,000 cords | 2,000 cords | 5 cords |
| 132 | do | do | 3,500 tons ¹ | 3,500 tons | 10 tons |
| 133 | do | do | | 1,000 cords | |
| 134 | do | do | 3,000 cords | 2,700 cords | 3 cords |
| 135 | do | do | 2,750 cords ¹ | 2,750 cords | |
| 136 | do | do | 2,200 cords ¹ | 2,200 cords | 2 to 3 cords |

¹Specified as 2,000 pounds.²Specified as 2,240 pounds.³Specified as 2,200 pounds.

returns by States.

NEW YORK.

(Table continued.)

| Number. | Price of bark. | | | Estimated duration of bark supply. |
|---------|-----------------------------|-----------------------------|---------------------------------|------------------------------------|
| | 1880. | 1881. | Range of prices since 1870. | |
| 70 | \$4 per ton..... | \$5 per ton..... | \$3.50 to \$5 per ton.... | Few years. |
| 71 | \$6 per cord..... | \$6 per cord..... | \$4 to \$6 per cord..... | 10 years. |
| 72 | \$6 per cord..... | \$6 per cord..... | \$6 per cord..... | 20 years. |
| 73 | \$4.50 per cord..... | \$4.50 per cord..... | \$4 to \$4.50 per cord..... | 30 to 50 years. |
| 74 | \$5.50 per cord..... | \$6 per cord..... | \$4.50 to \$6 per cord..... | 10 years. |
| 75 | \$5 to \$5.10 per ton..... | \$5 to \$5.10 per ton..... | | 15 to 20 years. |
| 76 | \$4.50 per ton..... | \$5 per ton..... | \$4 to \$5 per ton..... | 5 to 10 years. |
| 77 | \$4.50 per ton..... | \$5 per ton..... | \$3.50 to \$5 per ton..... | 10 to 15 years. |
| 78 | \$4.50 per ton..... | \$5 per ton..... | \$4 to \$5 per ton..... | 20 years. |
| 79 | \$3.75 per ton..... | \$4.25 per ton..... | \$3.50 to \$4.25 per ton..... | 10 years. |
| 80 | \$4.50 per ton..... | \$4.50 per cord..... | \$3.50 to \$5 per ton..... | 15 years. |
| 81 | \$4.75 per ton..... | \$5 per ton..... | \$3.75 to \$5 per ton..... | 8 to 10 years. |
| 82 | \$4.50 per cord..... | \$4.50 per cord..... | \$4.50 per cord..... | 50 years. |
| 83 | \$6 per cord..... | \$7 per cord..... | \$5.50 to \$7 per cord..... | 10 to 20 years. |
| 84 | \$5.50 per cord..... | \$6 per cord..... | \$4.50 to \$6 per cord..... | 5 to 10 years. |
| 85 | \$5.50 per ton..... | \$6.50 per ton..... | \$4.50 to \$7 per ton..... | 5 to 10 years. |
| 86 | \$5 per cord..... | \$5 per cord..... | \$4.50 to \$6.50 per cord..... | 20 years. |
| 87 | \$7 per cord..... | \$7 per cord..... | \$7 per cord..... | Nearly gone. |
| 88 | \$6.60 per cord..... | \$7 per cord..... | \$5.50 to \$7 per cord..... | Few years. |
| 89 | \$6.25 per cord..... | \$6.50 per cord..... | | 8 to 10 years. |
| 90 | \$9.00 per ton..... | \$10 per ton..... | \$7.50 to \$13 per ton..... | 40 years. |
| 91 | \$7 to \$7.50 per cord..... | \$7.50 per cord..... | \$7 to \$7.50 per cord..... | Nearly gone. |
| 92 | \$5.50 per cord..... | \$6.50 per cord..... | \$5 to \$6.50 per cord..... | 10 years. |
| 93 | \$6 per cord..... | \$5.75 per cord..... | \$5 to \$5.75 per cord..... | 5 years. |
| 94 | \$5 per cord..... | \$5 per cord..... | \$5 to \$6 per cord..... | 2 to 3 years. |
| 95 | \$5.50 per cord..... | \$6.50 per cord..... | \$5 to \$6.50 per cord..... | 8 to 10 years. |
| 96 | \$5 per cord..... | \$5.50 per cord..... | \$4 to \$6 per cord..... | |
| 97 | \$5.50 per cord..... | \$5.50 per cord..... | \$5 to \$9 per cord..... | 1 year. |
| 98 | \$5 per cord..... | \$5.50 per cord..... | | Very scarce. |
| 99 | \$6.50 per cord..... | \$7 to \$7.25 per cord..... | \$5.50 to \$7.50 per cord..... | |
| 100 | \$5 per ton..... | \$5.50 per ton..... | \$4 to \$5.50 per ton..... | 15 to 20 years. |
| 101 | \$5.50 per cord..... | \$6 per cord..... | \$5 to \$6 per cord..... | 2 years. |
| 102 | \$5.50 per cord..... | \$6 per cord..... | \$4.50 to \$6 per cord..... | 1 year. |
| 103 | \$7 per cord..... | \$7.25 per cord..... | \$6 to \$7.25 per cord..... | 4 to 5 years. |
| 104 | \$6 per cord..... | \$6 per cord..... | \$6 per cord..... | 10 years. |
| 105 | \$4 per cord..... | \$5.50 per cord..... | \$3 to \$5 per cord..... | Many years. |
| 106 | \$5 per cord..... | \$5 per cord..... | \$4 to \$5 per cord..... | 20 years. |
| 107 | \$4 per cord..... | \$4 per cord..... | \$3 to \$4 per cord..... | 20 years. |
| 108 | \$5 per ton..... | \$6 per ton..... | \$4 to \$6 per ton..... | 20 years. |
| 109 | \$8.50 per cord..... | \$8.50 per cord..... | \$7.50 to \$10.50 per cord..... | |
| 110 | \$3 per cord..... | \$4 per cord..... | \$3 to \$4 per cord..... | 25 years. |
| 111 | \$4.50 per cord..... | \$5 per cord..... | Average, \$4.50 per cord..... | 25 years. |
| 112 | \$4.50 per ton..... | \$5 per ton..... | \$3.50 to \$5 per ton..... | 10 years. |
| 113 | \$3.75 per cord..... | \$4 per cord..... | | 25 years. |
| 114 | \$5 per ton..... | \$5 per ton..... | \$5 per ton..... | 6 years. |
| 115 | \$5 per ton..... | \$5 per ton..... | \$4 to \$5 per ton..... | 6 years. |
| 116 | \$5.25 per ton..... | \$6 per ton..... | | 5 to 10 years. |
| 117 | \$5 to \$5.50 per ton..... | \$5 to \$5.50 per ton..... | \$4.50 to \$5.50 per ton..... | 2 to 4 years. |
| 118 | \$5.75 per ton..... | \$6 per ton..... | \$5 to \$6 per ton..... | 3 to 5 years. |
| 119 | \$4 per cord..... | \$4 per cord..... | \$3 to \$6 per cord..... | 5 years. |
| 120 | \$6 to \$7 per ton..... | \$6 to \$7 per ton..... | \$5 to \$7 per ton..... | Exhausted. |
| 121 | \$4.50 per cord..... | \$4.50 per cord..... | \$4 to \$5 per cord..... | 6 years. |
| 122 | \$4.50 per cord..... | \$4.50 per cord..... | \$4 to \$5 per cord..... | 1 year. |
| 123 | \$5 per cord..... | | \$4.50 to \$6 per cord..... | Exhausted. |
| 124 | \$5 to \$6 per ton..... | \$5.50 to \$6 per ton..... | \$4 to \$6 per ton..... | 5 to 10 years. |
| 125 | \$5 per ton..... | \$5.50 per ton..... | \$4 to \$5.75 per ton..... | 10 years. |
| 126 | \$5.25 per ton..... | \$5.50 per ton..... | \$4 to \$5.50 per ton..... | 5 to 6 years. |
| 127 | \$5.39 per ton..... | \$6 per ton..... | \$4.50 to \$6 per ton..... | About gone. |
| 128 | \$5 per ton..... | \$5 per ton..... | \$4.50 to \$5 per ton..... | 10 to 15 years. |
| 129 | \$4.25 per ton..... | \$4.25 per ton..... | \$4.25 per ton..... | 15 to 20 years. |
| 130 | \$4.50 per ton..... | \$4.50 per ton..... | \$4.50 to \$5 per ton..... | 1 year. |
| 131 | \$5 per cord..... | \$5.50 per cord..... | \$4.50 to \$5 per cord..... | 6 to 7 years. |
| 132 | \$4.50 per ton..... | \$5 per ton..... | | 10 years. |
| 133 | \$5 per cord..... | \$5 to \$6 per cord..... | \$4.50 to \$6 per cord..... | About gone. |
| 134 | \$4.75 per cord..... | \$5 per cord..... | \$4.50 to \$5 per cord..... | 10 years. |
| 135 | \$5 per cord..... | | \$5 to \$6 per cord..... | Do. |
| 136 | \$5 per cord..... | \$5.50 per cord..... | \$4 to \$5.50 per cord..... | 5 years. |

NEW YORK.

(Table continued.)

| Number. | Counties. | Kinds of bark used. | Quantities used. | | Yield of bark per acre. |
|---------|------------|---------------------|------------------------|-------------------|-------------------------|
| | | | 1880. | 1881 (estimated). | |
| 137 | Washington | Hemlock | 250 cords | 250 cords | |
| 138 | do | do | 75 cords | 75 cords | |
| 139 | Wayne | do | 15 cords | 15 cords | |
| 140 | do | do | 100 cords | 100 cords | |
| 141 | Wyoming | do | 400 cords ² | 400 cords | 15 cords |

²Specified as 2,200 pounds.

NORTH CAROLINA.

| | | | | | |
|----|---------------|--|------------------------|-----------|----------------|
| 1 | Alexander | Chestnut oak | 75 cords | 100 cords | 8 cords |
| 2 | do | do | 25 cords | 30 cords | 6 cords |
| 3 | do | Black, red, Spanish, and chestnut oak. | 30 cords | 30 cords | 4 to 5 cords |
| 4 | Anson | Black, red, Spanish, and white oak. | 25 cords | 25 cords | 2 cords |
| 5 | do | Red and Spanish oak | 50 cords | | 10 cords |
| 6 | Burke | Chestnut, black, red, and Spanish oak. | 30 cords | 30 cords | 10 cords |
| 7 | do | Chestnut oak | 50 cords | 50 cords | |
| 8 | Cleveland | Black, white, and chestnut oak. | 25 cords | 25 cords | |
| 9 | Davidson | Black, white, and Spanish oak. | 50 cords | | 15 to 20 cords |
| 10 | Forsyth | Black oak | 200 cords | 200 cords | |
| 11 | do | White, black, and chestnut oak. | 65 co. ds | 75 cords | 10 cords |
| 12 | Iredell | Black, white, red, and Spanish oak. | 25 to 30 cords | 25 cords | 8 to 12 cords |
| 13 | do | Black and red oak | 45 cords | 5 cords | |
| 14 | do | Black, red, and Spanish oak. | 125 cords | 125 cords | 10 to 15 cords |
| 15 | Lincoln | Black, red, Spanish, and white oak. | 75 cords | 75 cords | 3 cords |
| 16 | McDowell | Chestnut oak | 70 cords | 100 cords | 15 cords |
| 17 | Mecklenburgh. | Black and red oak | 125 cords | 125 cords | |
| 18 | do | do | 400 cords ¹ | 400 cords | 4 to 10 cords |
| 19 | Montgomery | White, red, and mountain oak. | 6 cords | 6 cords | |
| 20 | Randolph | Black and mountain oak | 250 cords | 250 cords | 5 to 6 cords |
| 21 | do | Black oak | 400 cords | 400 cords | |
| 22 | Rowan | Red, black, and Spanish oak. | 200 cords | 200 cords | 15 to 25 cords |
| 23 | Wake | Black oak | 40 cords | 50 cords | 5 cords |
| 24 | do | Black, white, and Spanish oak. | 300 cords | 300 cords | |

¹Specified as 2,000 pounds.

(19) OHIO.

| | | | | | |
|----|------------|--------------------------|-------------------------|------------|----------------|
| 1 | Ashland | Chestnut oak and extract | | | 40 cords |
| 2 | Ashtabula | Hemlock | 80 cords | 80 cords | |
| 3 | do | do | 300 cords | 300 cords | 10 cords |
| 4 | do | do | 125 cords | 150 cords | 5 to 10 cords |
| 5 | Athens | Chestnut oak | 200 cords | 250 cords | |
| 6 | Auglaize | White oak | 45 cords | 35 cords | |
| 7 | Butler | Chestnut oak | 200 cords | 300 cords | |
| 8 | Champaign | Chestnut and white oak | 200 cords | 200 cords | |
| 9 | do | Chestnut and black oak | 1,200 tons ^a | 1,200 tons | |
| 10 | Clermont | Chestnut oak | 100 cords | 125 cords | None here |
| 11 | do | White, black and pin oak | 70 cords | 60 cords | 10 cords |
| 12 | Columbiana | Chestnut and white oak | 20 cords | 25 cords | 40 to 60 cords |

^aSpecified as 2,000 pounds.

returns by States.

NEW YORK.

(Table continued.)

| Number. | Price of bark. | | | Estimated duration of bark supply. |
|---------|----------------------|----------------------|-----------------------------|------------------------------------|
| | 1880. | 1881. | Range of prices since 1879. | |
| 137 | \$5 per cord..... | \$6 per cord..... | \$4 to \$6 per cord..... | 40 to 50 years. |
| 138 | \$7 per cord..... | \$7 per cord..... | \$7 to \$10 per cord..... | 10 years. |
| 139 | \$4.50 per cord..... | \$4.75 per cord..... | | |
| 140 | \$6.25 per cord..... | \$6.25 per cord..... | \$5 to \$6 per cord..... | 5 to 10 years. |
| 141 | \$5 per cord..... | \$6 per cord..... | \$4.50 to \$6 per cord..... | 6 to 10 years. |

NORTH CAROLINA.

| | | | | |
|----|----------------------------|----------------------------|-----------------------------|-----------------|
| 1 | \$2.25 per cord..... | \$2.25 per cord..... | \$2.25 per cord..... | 30 to 40 years. |
| 2 | \$3 per cord..... | \$3 per cord..... | \$3 per cord..... | 20 years. |
| 3 | \$2.75 per cord..... | \$2.75 per cord..... | \$2.75 per cord..... | Indefinitely. |
| 4 | \$4.00 per cord..... | \$4 per cord..... | | 5 years. |
| 5 | \$5 per cord..... | \$5 per cord..... | \$5 to \$6 per cord..... | About gone. |
| 6 | \$3 per cord..... | \$3 per cord..... | \$3 per cord..... | 50 to 75 years. |
| 7 | \$3 per cord..... | \$3 per cord..... | | 50 years. |
| 8 | \$3 per cord..... | \$3 per cord..... | \$3 per cord..... | Many years. |
| 9 | \$4 per cord..... | \$4 per cord..... | \$2.50 to \$4 per cord.... | Do. |
| 10 | \$3.50 to \$4 per cord... | \$4 per cord..... | \$3.50 to \$4 per cord.... | |
| 11 | \$4 per cord..... | \$4 per cord..... | \$3.75 to \$4 per cord.... | 25 to 30 years. |
| 12 | \$3 per cord..... | \$3 per cord..... | \$2.50 to \$3.50 per cord.. | |
| 13 | \$3 per cord..... | \$3 per cord..... | \$3 to \$3.50 per cord.... | Many years. |
| 14 | \$3 per cord..... | \$3 per cord..... | \$3 to \$4 per cord..... | 25 years. |
| 15 | \$3.50 per cord..... | \$4 per cord..... | \$3.50 to \$4 per cord.... | 5 years. |
| 16 | \$3 per cord..... | \$3 per cord..... | \$2.50 to \$3 per cord.... | 25 years. |
| 17 | \$4 per cord..... | \$4 per cord..... | \$4 to \$5 per cord..... | |
| 18 | \$5 per cord..... | \$5 per cord..... | \$5 per cord..... | 40 to 50 years. |
| 19 | \$2.50 per cord..... | \$2.60 per cord..... | \$2.25 to \$2.60 per cord.. | 100 years. |
| 20 | \$3 per cord..... | \$3 per cord..... | \$2.50 to \$3 per cord.... | 10 years. |
| 21 | \$3 per cord..... | \$3.50 per cord..... | \$3 to \$4 per cord..... | 5 to 10 years. |
| 22 | \$3.50 to \$3.75 per cord. | \$3.50 to \$3.75 per cord. | \$3.50 to \$4 per cord.... | 60 to 75 years. |
| 23 | \$3 per cord..... | \$3 per cord..... | \$3 per cord..... | 50 years. |
| 24 | \$4 per cord..... | \$4.50 per cord..... | \$3 to \$4.50 per cord.... | 5 years. |

(19.) OHIO.

| | | | | |
|----|-------------------------------|--|--|-----------------|
| 1 | \$5 per cord..... | \$5 per cord..... | \$5 per cord..... | 10 years. |
| 2 | do..... | \$5.50 per cord..... | \$4 to \$5.50 per cord.... | 4 to 5 years. |
| 3 | \$6.50 per cord..... | \$7 per cord..... | \$5 to \$7 per cord..... | 2 years. |
| 4 | \$4.50 per cord..... | \$5 per cord..... | \$4 to \$5 per cord..... | 10 to 15 years. |
| 5 | \$6 per cord..... | \$8 per cord..... | \$4.50 to \$8 per cord.... | 5 years. |
| 6 | \$4 per cord..... | \$6 per cord..... | \$4 to \$6 per cord..... | 10 years. |
| 7 | \$18 per cord..... | \$15 per cord..... | \$11 to \$15 per cord.... | |
| 8 | \$4 white and \$12 chest-nut. | \$4 white and \$12 chest-nut per cord. | \$4 per cord; white oak, \$12 per cord; chest-nut, \$6 per cord. | |
| 9 | \$6 and \$11.50 per ton.. | | | |
| 10 | \$15 per cord..... | \$17 per cord..... | \$8.50 to \$17 per cord.... | |
| 11 | \$5 per cord..... | \$5 per cord..... | \$4 to \$5 per cord..... | 5 years. |
| 12 | \$7 per cord..... | \$8 per cord..... | \$6 to \$11 per cord..... | 40 to 50 years. |

(19.) OHIO.

(Table continued.)

| Number. | Counties. | Kinds of bark used. | Quantities used. | | Yield of bark per acre. |
|---------|------------|--|--------------------------|-------------------|-------------------------|
| | | | 1880. | 1881 (estimated). | |
| 13 | Columbiana | Chestnut and white oak and hemlock. | 25 cords | 25 cords | |
| 14 | do | Chestnut oak | 20 cords | 25 cords | 30 to 50 cords |
| 15 | do | White and black oak | 18 cords | 18 cords | 3 cords |
| 16 | Coshocton | Black and chestnut oak | 50 cords | 50 cords | |
| 17 | Cuyahoga | Hemlock and oak | 300 cords | 500 cords | None here |
| 18 | Darke | White and black oak | 200 cords | 200 cords | 30 cords |
| 19 | Defiance | White and black oak | 200 cords | 150 cords | 300 cords |
| 20 | do | White oak | 30 cords | 40 cords | 10 cords |
| 21 | Fairfield | Chestnut oak and hemlock | 500 cords | 600 cords | |
| 22 | do | Chestnut and rock oak | 50 cords | | |
| 23 | Franklin | Chestnut oak | 1,200 cords ² | 2,000 cords | None here |
| 24 | do | do | 400 tons ² | 600 tons | 15 to 18 tons |
| 25 | Gallia | do | 100 cords | 900 cords | |
| 26 | Gurnsey | do | 70 cords | 70 cords | 10 to 15 cords |
| 27 | do | Black and chestnut oak | 30 cords | 30 to 40 cords | |
| 28 | Hamilton | Chestnut oak | 900 cords ² | 900 cords | None here |
| 29 | do | do | 1,350 cords | 1,500 cords | |
| 30 | do | do | 600 cords | 400 cords | |
| 31 | do | do | 1,500 cords ² | 1,500 cords | |
| 32 | do | do | 1,638 cords | 2,000 cords | |
| 33 | Hancock | White and burr oak and beach. | 50 cords | 50 cords | |
| 34 | Hardin | White oak and hemlock | 50 cords | 50 cords | |
| 35 | Harrison | Chestnut oak | 35 cords | 35 cords | 3 to 10 cords |
| 36 | do | Chestnut and black oak | 50 cords | 50 cords | |
| 37 | do | Chestnut oak | 40 cords | 40 cords | 2 cords |
| 38 | do | White and black oak | 40 cords | 40 cords | |
| 39 | Highland | Chestnut oak | 150 cords | 150 cords | 75 cords |
| 40 | do | do | 100 cords | | |
| 41 | Huron | White oak | 10 cords | 10 cords | |
| 42 | do | do | 80 cords | 80 cords | 4 cords |
| 43 | Knox | White and black oak and hemlock. | 70 cords | 70 cords | |
| 44 | Lake | Rock and chestnut, oak and hemlock. | 100 cords | 200 cords | 20 cords |
| 45 | Licking | Chestnut, black, and white oak. | 35 cords | 40 cords | |
| 46 | Lucas | Chestnut oak | 150 cords | 200 cords | 20 cords |
| 47 | Mahoning | White oak and hemlock | 110 cords | 150 cords | |
| 48 | do | White oak | 75 cords | 75 cords | 25 cords |
| 49 | do | do | 120 cords | 132 cords | |
| 50 | do | do | 75 cords | 40 cords | |
| 51 | Medina | Oak and hemlock | 50 cords | 70 cords | |
| 52 | Meigs | Chestnut | 50 cords | 50 cords | $\frac{1}{2}$ cord |
| 53 | do | Chestnut oak | 125 cords | 125 cords | |
| 54 | Mercer | White and black oak and hemlock. | 150 cords | 150 cords | $\frac{1}{2}$ cord |
| 55 | Montgomery | Chestnut oak | 400 cords ¹ | 400 cords | |
| 56 | do | do | 350 to 400 cords | 400 to 450 cords | All gone |
| 57 | Morrow | White and chestnut oak | 70 cords | 60 cords | $\frac{1}{10}$ cord |
| 58 | Muskingum | Chestnut and black oak | 15 cords | 10 cords | 30 cords |
| 59 | Noble | Chestnut oak | 20 cords | 30 cords | 20 cords |
| 60 | Perry | Black, white, and chestnut oak. | 60 cords | 60 cords | 100 cords |
| 61 | Portage | White oak | 125 cords | 125 cords | 40 cords |
| 62 | Pickaway | Chestnut oak | 600 cords ² | 600 to 700 cords | None here |
| 63 | Preble | do | 150 cords | 125 cords | do |
| 64 | Ross | do | 700 tons | | |
| 65 | do | do | 100 cords | 100 cords | |
| 66 | do | do | 900 cords | | |
| 67 | Seneca | White oak and extract of chestnut oak. | 150 cords | 100 cords | |
| 68 | Shelby | White oak | 10 cords | 3 cords | |
| 69 | Stark | White and black oak | 125 cords | 125 cords | 8 cords |
| 70 | Trumbull | Hemlock and oak | 50 cords | 70 cords | None here |
| 71 | Tuscarawas | Chestnut oak | 77 cords | 110 cords | |

¹ Specified as 160 feet. ² Specified as 2,000 pounds.

returns by States.

(19.) OHIO.

(Table continued.)

| Number. | Price of bark. | | | Estimated duration of bark supply. |
|---------|---|--|--------------------------------|------------------------------------|
| | 1880. | 1881. | Range of prices since 1870. | |
| 13 | \$8.50 per cord..... | \$10.50 per cord..... | \$6.25 to \$12 per cord... | |
| 14 | \$10 per cord..... | \$11 per cord..... | \$8 to \$11 per cord..... | 30 years. |
| 15 | \$4 per cord..... | \$4 per cord..... | \$4 to \$5 per cord..... | 50 years. |
| 16 | \$5.50 per cord..... | \$5.50 per cord..... | \$5.50 per cord..... | 20 years. |
| 17 | \$6.50 per cord..... | \$8 per cord..... | per cord..... | 5 years. |
| 18 | \$6 per cord..... | \$7 per cord..... | per cord..... | 25 years |
| 19 | \$5 per cord..... | \$5 per cord..... | \$4 to \$5 per cord..... | |
| 20 | \$5 per cord..... | \$5.50 per cord..... | \$5 to \$6 per cord..... | 10 years. |
| 21 | \$7 to \$10 per cord..... | \$7 to \$12 per cord..... | \$6 to \$12 per cord..... | |
| 22 | \$8 to \$10 per cord..... | \$8 to \$10 per cord..... | per cord..... | |
| 23 | \$8 per cord..... | \$10.50 per cord..... | per cord..... | 20 years. |
| 24 | \$8 per ton..... | \$10.50 per ton..... | \$7 to \$10.50 per ton..... | 50 years. |
| 25 | \$7 per cord..... | \$9 per cord..... | \$7 to \$10.50 per cord... | 10 to 20 years. |
| 26 | \$6 per cord..... | \$6 per cord..... | \$5 to \$8 per cord..... | 10 to 20 years. |
| 27 | \$6 per cord..... | \$6 per cord..... | \$6 to \$8 per cord..... | 10 to 20 years. |
| 28 | \$17 per cord..... | \$15 per cord..... | \$11 to \$19 per cord..... | |
| 29 | \$17 per cord..... | \$15 per cord..... | \$9 to \$16 per cord..... | 25 to 50 years. |
| 30 | per cord..... | \$15 per cord..... | per cord..... | |
| 31 | \$16 per cord..... | \$15 per cord..... | \$15 to \$20 per cord..... | |
| 32 | \$13.80 per cord..... | \$15 per cord..... | \$12.60 to \$15.50 cord..... | |
| 33 | \$5 per cord..... | \$5 per cord..... | \$5 per cord..... | Scarce. |
| 34 | Oak \$4.50, hemlock \$8 per cord..... | Oak \$4.50, hemlock \$9.50 per cord..... | | About gonee |
| 35 | \$6 per cord..... | \$6 per cord..... | | 10 years. |
| 36 | \$6 per cord..... | \$6 per cord..... | \$5.50 to \$8 per cord..... | 10 years. |
| 37 | \$7 per cord..... | \$8 per cord..... | \$5 to \$8 per cord..... | 10 years. |
| 38 | \$4 per cord..... | \$4 per cord..... | \$4 per cord..... | 20 years. |
| 39 | \$7 per cord..... | \$9 per cord..... | \$7 to \$9 per cord..... | 5 to 10 years. |
| 40 | \$7 per cord..... | \$8.50 per cord..... | \$7 to \$8.50 per cord..... | |
| 41 | \$4 per cord..... | \$4 per cord..... | \$4 per cord..... | Indefinitely. |
| 42 | \$4.50 per cord..... | \$5 per cord..... | \$4 to \$5 per cord..... | 5 years. |
| 43 | \$3.75 per cord..... | \$6 per cord..... | \$5 to \$6 per cord..... | |
| 44 | \$8.25 per cord..... | \$8.80 per cord..... | \$7 to \$8.80 per cord..... | |
| 45 | \$4.75 per cord..... | \$5.50 per cord..... | \$4.75 per cord..... | 50 years. |
| 46 | \$7 per cord..... | \$8 per cord..... | \$6.50 to 8 per cord..... | 10 years. |
| 47 | \$3.50 per cord..... | \$4.25 per cord, oak; \$7.05 per cord, hemlock. | | 25 years. |
| 48 | \$5 per cord..... | \$5 per cord..... | \$4 to \$7 per cord..... | 5 years. |
| 49 | \$4 per cord..... | do..... | \$4 to \$6 per cord..... | 20 years. |
| 50 | \$4.50 per cord..... | do..... | \$3 to \$5 per cord..... | Exhausted. |
| 51 | \$5 per cord, oak; \$8 per cord hemlock. | \$6 per cord, oak; \$9 per cord, hemlock. | | 10 years. |
| 52 | \$6 per cord..... | \$6 per cord..... | \$6 per cord..... | ...do. |
| 53 | \$7 per cord..... | do..... | \$6 to \$7 per cord..... | ...do. |
| 54 | \$10 per cord, hemlock; \$6 per cord oak. | \$10 per cord, hemlock; \$6 to \$7 per cord, oak. | \$4 to \$7 per cord..... | 5 years. |
| 55 | \$10 per cord..... | \$10 per cord..... | | 20 years. |
| 56 | \$14.50 per cord..... | do..... | | |
| 57 | \$5 per cord..... | \$5 per cord..... | \$5 to \$6.50 per cord..... | 2 years. |
| 58 | \$7.50 per cord..... | \$8 per cord..... | \$7.50 to \$10 per cord..... | 50 years. |
| 59 | \$6.50 per cord..... | \$6.50 per cord..... | \$6.50 to \$5 per cord..... | A number of years. |
| 60 | \$7 per cord..... | \$8 per cord..... | \$7 to \$9 per cord..... | Fast failing. |
| 61 | \$4.50 per cord..... | \$4.50 per cord..... | \$4.50 to \$6.50 per cord..... | 15 to 20 years. |
| 62 | \$7 per cord..... | \$9 per cord..... | \$7 to \$12 per cord..... | Few years. |
| 63 | \$14 per cord..... | \$15 per cord..... | | |
| 64 | \$8 per cord..... | \$10 per ton..... | \$5 to \$10 per ton..... | 50 years. |
| 65 | \$6 per cord..... | \$7 per cord..... | \$4.50 to \$7 per cord..... | |
| 66 | \$7.50 per cord..... | \$10 per cord..... | \$6 to \$10 per cord..... | 10 years. |
| 67 | \$4 per cord..... | \$4.75 per cord..... | \$3.50 to \$5 per cord..... | 20 years. |
| 68 | \$5 per cord..... | \$5 per cord..... | \$5 to \$6 per cord..... | |
| 69 | \$4.50 per cord..... | \$4.50 per cord..... | \$4.50 to \$5 per cord..... | 10 years. |
| 70 | \$6 per cord..... | \$6 per cord..... | \$6 to \$7 per cord..... | 20 years. |
| 71 | \$7 per cord..... | \$7 per cord..... | \$6 to \$9 per cord..... | |

(19.) OHIO.

(Table continued.)

| Number. | Counties. | Kinds of bark used. | Quantities used. | | Yield of bark per acre. |
|---------|---------------|--------------------------------------|------------------|-------------------|-------------------------|
| | | | 1880. | 1881 (estimated). | |
| 72 | Van Wert..... | Chestnut oak | | 90 cords..... | None here |
| 73 | Vinton | do | 75 cords..... | 80 cords..... | |
| 74 | do | do | 150 cords..... | 150 cords..... | |
| 75 | Washington .. | Chestnut and black oak... | 80 cords..... | 80 cords..... | $\frac{3}{4}$ cord..... |
| 76 | do | Chestnut oak | 600 cords..... | 600 cords..... | |
| 77 | Wayne..... | White and black oak and oak extract. | 150 cords..... | 150 cords..... | |
| 78 | do | White and black oak..... | 100 cords..... | 80 cords..... | 8 cords..... |
| 79 | do | White oak..... | 80 cords..... | 80 cords..... | $\frac{3}{4}$ cord..... |
| 80 | Williams..... | White oak and hemlock... | 100 cords..... | 100 cords..... | 5 cords..... |
| 81 | Wood..... | Oak and hemlock..... | 54 cords..... | 54 cords..... | |
| 82 | do | White oak..... | 75 cords..... | 75 cords..... | 5 cords..... |
| 83 | Wyandot..... | White and black oak..... | 40 cords..... | 50 cords..... | 1 cord..... |

(20.) OREGON.

| | | | | | |
|---|----------------|-----------------------------|-----------------|----------------|------------------|
| 1 | Clackamas..... | Red, yellow, and white fir. | | | 1,000 cords.... |
| 2 | Clatsop | Hemlock | 300 cords | 300 cords..... | |
| 3 | Coos | Fir and hemlock..... | 25 cords | 85 cords..... | 20 cords..... |
| 4 | Lynn | do | 95 cords | 95 cords..... | |
| 5 | Marion | do | 150 cords..... | | 100 to 600 cords |
| 6 | Multnomah... | Hemlock, fir, and oak..... | 400 cords..... | | |

(21.) PENNSYLVANIA.

| | | | | | |
|----|--------------|-------------------------------------|--------------------------------|------------------------------------|--------------------|
| 1 | Adams..... | Chestnut oak | 75 tons ¹ | 75 tons..... | |
| 2 | do | do | 175 tons ¹ | 150 tons..... | 3 to 5 tons..... |
| 3 | Allegheny .. | do | 2,500 cords..... | 3,000 cords..... | None here |
| 4 | do | Rock oak and hemlock | 2,200 cords..... | 2,200 cords..... | |
| 5 | do | Chestnut oak | 7,000 cords..... | 7,000 cords..... | About gone..... |
| 6 | do | Oak and hemlock..... | 3,900 cords..... | 3,500 cords oak, 1,000 hemlock. | None here |
| 7 | do | Hemlock | None | 600 cords..... | 10 to 12 cords.. |
| 8 | Armstrong .. | White and chestnut oak .. | 30 cords | 30 cords..... | 10 to 20 cords.. |
| 9 | do | Chestnut oak | 10 cords | 10 cords..... | Limited |
| 10 | do | do | 60 cords | 120 cords..... | 2 to 4 cords..... |
| 11 | Beaver | do | 70 cords | 70 cords..... | |
| 12 | Bedford..... | Chestnut and black oak .. | 50 cords | 100 cords..... | |
| 13 | do | Chestnut oak | 9,000 cords | 9,000 cords..... | 2½ to 3 cords..... |
| 14 | do | do | 1,250 cords | 1,325 cords..... | 4 to 12 cords..... |
| 15 | do | do | 125 cords..... | 125 cords..... | |
| 16 | do | do | 160 cords..... | 160 cords..... | 8 to 10 cords..... |
| 17 | do | do | 150 cords..... | 175 cords..... | 40 cords..... |
| 18 | Berks..... | Chestnut oak | 600 tons ¹ | 700 tons..... | |
| 19 | do | do | 250 tons..... | 250 tons..... | |
| 20 | do | Rock and black oak..... | 75 tons ¹ | 75 tons..... | |
| 21 | do | Chestnut and black oak and hemlock. | 1,200 tons ¹ | 1,200 tons, 200 cords oak. | 150 tons..... |
| 22 | Blair..... | Oak and hemlock | 200 tons oak, 400 hemlock. | 400 cords hemlock. | 5 to 20 cords..... |
| 23 | Blair..... | Rock oak and hemlock | | 1,000 cords ¹ | 10 to 15 cords.. |
| 24 | Bedford..... | Chestnut oak | 100 cords..... | 100 cords..... | 8 to 10 cords .. |
| 25 | Bradford .. | Hemlock and oak..... | 1,700 tons ¹ | 1,700 tons..... | 7 tons..... |
| 26 | do | do | 2,250 tons ¹ | 2,250 tons..... | 7 to 10 tons..... |
| 27 | do | do | 1,300 tons ¹ | 1,300 tons..... | 5 to 10 tons..... |
| 28 | do | Hemlock | 50 cords..... | 40 cords..... | |
| 29 | do | Oak and hemlock..... | 1,200 tons ¹ | 1,200 tons..... | |
| 30 | do | do | 920 tons ¹ | 1,030 tons..... | 15 tons..... |
| 31 | do | do | 6 to 8 tons ² | 6 to 8 tons..... | |

¹ Specified as 2,000 pounds.² Specified as 2,200 pounds.

returns by States.

(19.) OHIO.

(Table continued.)

| Number. | Price of bark. | | | Estimated duration of bark supply. |
|---------|--|--|-----------------------------|------------------------------------|
| | 1880. | 1881. | Range of prices since 1870. | |
| 72 | \$14 per cord..... | \$14 per cord..... | \$11 to \$14 per cord.... | |
| 73 | \$5.50 per cord..... | \$8 per cord..... | | |
| 74 | \$6 per cord..... | \$9 per cord..... | \$4 to \$9 per cord..... | 5 to 6 years. |
| 75 | \$7 per cord..... | \$8 per cord..... | \$7 to \$8 per cord..... | 8 to 12 years. |
| 76 | \$7 per cord..... | \$8 per cord..... | \$5 to \$8 per cord..... | About gone. |
| 77 | \$5.14 per cord..... | \$4.93 per cord..... | \$4.93 to \$6 per cord.... | 15 years. |
| 78 | \$5.50 per cord..... | \$5.75 per cord..... | \$5 to \$5.75 per cord.... | 20 years. |
| 79 | \$3.25 per cord..... | \$3.50 per cord..... | \$3.25 to \$6 per cord.... | 20 to 30 years. |
| 80 | | | | 10 to 20 years. |
| 81 | { Oak \$4.50 per cord.. Hemlock \$3.50 per cord. | { Oak \$4.50 per cord.. Hemlock \$3.50 per cord. } | | 50 years. |
| 82 | \$5 per cord..... | | \$5 to \$7 per cord..... | 10 years. |
| 83 | \$3.50 per cord..... | \$3.75 per cord..... | \$3.50 to \$5.50 per cord. | 10 years. |

(20.) OREGON.

| | | | | |
|---|-----------------------------|----------------------------|----------------------------|------------|
| 1 | \$4 per cord..... | \$4 per cord..... | \$4 per cord..... | Always. |
| 2 | \$7.50 to \$8 per cord.... | \$7.50 to \$8 per cord.... | \$7.50 to \$8 per cord.... | 100 years. |
| 3 | \$5 per cord..... | \$5 per cord..... | | Always. |
| 4 | \$5 to \$9 per cord..... | | | 200 years. |
| 5 | \$4 to \$10 per cord..... | | \$4 to \$12 per cord..... | Always. |
| 6 | \$4, \$7, and \$8 per cord. | | | |

(21.) PENNSYLVANIA.

| | | | | |
|----|--|-----------------------------|--|-----------------|
| 1 | \$8 per ton..... | \$9 per ton..... | \$6 to \$9 per ton..... | About gone. |
| 2 | \$7 per ton..... | \$7.50 per ton..... | \$6 to \$8 per ton..... | 15 to 20 years. |
| 3 | \$10.50 per cord..... | \$11.50 per cord..... | \$9 to \$7.50 per cord.... | |
| 4 | \$7.50 to \$11 per cord.... | \$7.50 to \$11 per cord.... | Oak \$7.50 per cord, hemlock \$11 per cord. | Many years. |
| 5 | \$12 per cord..... | \$12 per cord..... | \$9 to \$13 per cord..... | 50 years. |
| 6 | \$11 and \$7.50 per cord. | \$11 and \$7.50 per cord. | \$9 to \$14 per cord, oak.. | |
| 7 | \$7.50 per cord..... | \$7.25 per cord..... | | |
| 8 | \$4.50 to \$5 per cord.... | \$5 to \$5.50 per cord.... | \$4 to \$9 per cord..... | 25 to 30 years. |
| 9 | \$4 per cord..... | \$4 per cord..... | | 10 years. |
| 10 | \$4.25 per cord..... | \$5.25 per cord..... | \$4 to \$5 per cord..... | 10 to 15 years. |
| 11 | \$8 per cord..... | \$10 per cord..... | \$6 to \$10 per cord..... | 8 to 10 years. |
| 12 | \$7 per cord..... | \$7 per cord..... | \$6 to \$7 per cord..... | About gone. |
| 13 | \$6.50 per cord..... | \$7.50 per cord..... | \$5 to \$8 per cord..... | 10 years. |
| 14 | \$6 per cord..... | \$6.50 per cord..... | \$4.50 to \$7.50 per cord. | 25 years. |
| 15 | \$6.50 per cord..... | \$6.50 per cord..... | \$4 to \$6.50 per cord.... | 20 years. |
| 16 | \$7 per cord..... | \$7 per cord..... | | 8 to 10 years. |
| 17 | \$3.50 per cord..... | \$9 per cord..... | \$4 to \$6.50 per cord.... | 30 years. |
| 18 | \$10 per ton..... | \$10 per ton..... | \$8 to \$14 per cord..... | 20 years. |
| 19 | \$9 per ton..... | \$10 per ton..... | Average, \$7.50 per ton. | 2 years. |
| 20 | \$5 to \$11 per ton..... | \$5 to \$11 per ton..... | \$3 and \$9 to \$5 and \$11 per ton. | 25 years. |
| 21 | \$9.50 per ton..... | \$10 per ton..... | \$6.50 to \$13 per ton.... | Few years. |
| 22 | \$5 to \$7 per cord..... | \$5 to \$7 per cord..... | | 25 to 30 years. |
| 23 | \$6 to \$6.50 and \$8 to 8.50 per cord. | | \$7 to \$8, and \$5.75 to \$8.50 per cord. | 10 to 15 years. |
| 24 | \$6 to \$7 per cord..... | \$6 to \$7 per cord..... | \$4 to \$7 per cord..... | 5 years. |
| 25 | \$5 per ton..... | \$5.50 per ton..... | \$4.00 to \$5 per ton.... | |
| 26 | \$4.40 per ton..... | \$5 per ton..... | \$4.20 to \$5 per ton.... | |
| 27 | \$5 per ton..... | \$5 per ton..... | \$5 per ton..... | 10 years. |
| 28 | \$3.50 per cord..... | \$4 per cord..... | \$3.50 to \$4 per cord.... | 50 years. |
| 29 | \$5 per ton..... | \$5 per ton..... | \$4 to \$5 per ton..... | Few years. |
| 30 | \$5.50 per ton..... | \$5.50 per ton..... | \$3.75 to \$5.50 per ton.. | 6 years. |
| 31 | \$5 per ton..... | \$5.50 to \$5.75 per ton.. | \$3 to \$5.50 per ton.... | |

(Table continued.)

PENNSYLVANIA.

| Number. | Counties. | Kinds of bark used. | Quantities used. | | Yield of bark per acre. |
|---------|------------|--|-------------------------------------|-------------------------|-------------------------|
| | | | 1880. | 1881 (estimated). | |
| 32 | Bucks | Rock oak | 60 cords | 60 cords | 3 cords |
| 33 | do | Chestnut and black oak and birch. | 50 cords | 90 cords | 15 to 20 cords |
| 34 | do | Rock, red, and black oak | 100 cords | 100 cords | 50 cords |
| 35 | Cambria | Oak and hemlock | 25 cords | Closing out | 10 cords |
| 36 | do | Hemlock | 4,500 cords | 5,000 cords | 3 tons |
| 37 | Cameron | Rock oak | 700 tons ² | 1,000 tons | 5-10 tons |
| 38 | Centre | Rock oak and hemlock | 7,000 tons | 7,000 tons | 8 cords |
| 39 | do | Chestnut oak and hemlock | 70 tons | 80 cords | 3-5 cords |
| 40 | do | do | 40 to 50 tons | 40 to 50 cords | 10 cords |
| 41 | Clarion | Oak and hemlock | 10 to 15 tons | 10 to 15 cords | 3-5 cords |
| 42 | do | do | 50 tons | 80 cords | 10 cords |
| 43 | Clearfield | Chestnut oak and hemlock | 200 tons | 200 tons ¹ | 8 to 10 cords |
| 44 | do | Oak and hemlock | 350 tons | 400 cords | |
| 45 | Clinton | Oak and hemlock | 2,100 tons ¹ | 2,100 tons | |
| 46 | Clinton | do | 8,000 tons | 12,000 tons | |
| 47 | do | do | | | |
| 48 | Columbia | Oak | 200 tons ¹ | | |
| 49 | do | Red oak and hemlock | 600 tons ¹ | 600 tons | |
| 50 | Crawford | Hemlock | 25 cords | | |
| 51 | do | Hemlock and oak | 750 cords | 750 cords | 5 to 10 cords |
| 52 | do | do | 800 cords | 1,200 cords | 20 cords |
| 53 | Cumberland | Chestnut oak | 750 tons ¹ | 750 tons | 10 to 20 tons |
| 54 | do | do | 130 tons ¹ | 60 to 80 tons | 2 to 5 tons |
| 55 | do | Rock, red, and white oak | 325 tons ¹ | 180 tons | 2 to 20 tons |
| 56 | do | Chestnut oak | 750 tons ¹ | 750 tons | 2 to 8 tons |
| 57 | do | do | 60 tons ¹ | 60 tons | |
| 58 | do | Chestnut and black oak | 40 tons ¹ | 50 tons | |
| 59 | do | Chestnut oak | 200 tons ² | 200 tons | 1 to 20 tons |
| 60 | Dauphin | do | 1,096 tons ¹ | 1,000 tons | |
| 61 | do | Chestnut and black oak and hemlock | 100 tons ¹ | 100 tons | |
| 62 | Elk | Hemlock | 7,500 cords | | 8 cords |
| 63 | do | do | 1,300 cords ² | 15,000 cords | 10 cords |
| 64 | do | do | 3,000 cords | 5,000 cords | 8 cords |
| 65 | do | do | 500 cords | 500 cords | 10 cords |
| 66 | Erie | do | 375 cords | 375 cords | |
| 67 | do | do | 500 cords | 500 to 600 cords | 15 to 30 cords |
| 68 | do | do | 200 cords | 250 cords | |
| 69 | Erie | Hemlock | 300 cords | 300 cords | |
| 70 | do | do | 400 cords ¹ | 800 cords | |
| 71 | Fayette | Chestnut oak | 200 cords | 250 cords | |
| 72 | do | Chestnut and black oak | 15 cords | | |
| 73 | do | Chestnut and rock oak | 100 cords | | |
| 74 | do | Chestnut oak | 250 cords | 250 cords | 5 cords |
| 75 | do | do | 140 cords | 160 cords | |
| 76 | Forest | Hemlock | 8,300 cords | 10,000 cords | 8 cords |
| 77 | Franklin | Chestnut oak | 100 tons ¹ | 100 tons | 4 cords |
| 78 | do | do | 175 tons ¹ | 250 tons | 5 to 10 tons |
| 79 | Fulton | do | 1,200 tons ¹ | 1,300 tons | 3 to 8 tons |
| 80 | do | Chestnut, black, and red oak. | 100 cords | | 20 cords |
| 81 | do | Rock oak | 300 tons ¹ | 400 tons | |
| 82 | Huntingdon | Chestnut oak | 2,600 tons ¹ | 2,700 tons | 6 tons |
| 83 | do | do | 2,500 tons | 3,000 tons | |
| 84 | do | Rock oak and hemlock | 3,500 tons oak 500 tons hemlock. | 4,000 tons ¹ | 5 tons |
| 85 | do | Chestnut oak | 30 cords | 30 cords | 6 cords |
| 86 | do | do | 30 cords | 40 cords | 5 cords |
| 87 | Indiana | Chestnut oak and hemlock | 200 cords | 200 cords | |
| 88 | do | Chestnut, black, and white oak and spruce. | 35 cords | 35 cords | 10 to 50 cords |
| 89 | do | Chestnut and black oak | 300 cords | 350 cords | |
| 90 | do | Oak | 350 cords | 125 cords | |
| 91 | Jefferson | Hemlock | 75 cords | 125 cords | |
| 92 | Juniata | Chestnut oak | | 1,800 tons ¹ | |
| 93 | do | Chestnut and black oak | 120 cords | 120 cords | |
| 94 | do | Chestnut oak | 25 tons ¹ | | 2 to 20 tons |

¹Specified as 2,000 pounds.²Specified as 2,240 pounds.³Specified as 2,200 pounds.

returns by States.

(Table continued.)

PENNSYLVANIA.

| Number. | Price of bark. | | | Estimated duration of bark supply. |
|---------|------------------------------------|------------------------------------|--|------------------------------------|
| | 1880. | 1881. | Range of prices since 1870. | |
| 32 | \$7 per ton..... | \$8 per ton..... | \$6 to \$8 per ton..... | 50 years. |
| 33 | \$4 to \$7 and \$8 per ton. | \$4, \$7, and \$8 per cord..... | | 15 years. |
| 34 | \$8 per ton..... | \$8 per cord..... | \$8 to \$11 per ton..... | |
| 35 | \$5 per ton..... | \$6.50 per ton..... | \$3.50 to \$6.50 per ton.. | About gone. |
| 36 | \$4.25 per cord..... | \$4.50 per cord..... | \$3.25 to \$4.50 per cord. | 8 to 10 years. |
| 37 | \$4.75 per cord..... | \$4.75 per cord..... | \$4 to \$5 per cord..... | Many years. |
| 38 | \$7 per ton..... | \$7.50 per ton..... | \$6 to \$7.50 per ton..... | |
| 39 | \$6 per ton..... | \$6.50 per ton..... | \$6 to \$6.50 per ton..... | 5 to 10 years. |
| 40 | \$6.50 per cord..... | \$6.50 per cord..... | | 20 years. |
| 41 | \$6 per cord..... | \$7 per cord..... | \$6 to \$7.50 per cord..... | |
| 42 | \$6 per cord..... | \$6 per cord..... | | 50 years. |
| 43 | \$2.50 and \$4 per ton... | \$3.50 and \$5 per cord... | | |
| 44 | \$5 and \$8 per cord..... | \$5 and \$8 per ton..... | | 12 to 15 years. |
| 45 | \$3 and \$5 per cord..... | \$4 and \$6 per cord..... | | 50 years. |
| 46 | \$5.25 and \$7.25 per ton | \$5.75 and \$7.75 per ton | | 20 to 30 years. |
| 47 | \$6 per ton..... | \$6.25 per ton..... | \$5 to \$6 per cord for hemlock, \$6 to \$9 per cord for oak. | 40 years. |
| 48 | \$7 per ton..... | \$7.50 per ton..... | \$5 to \$7 per ton..... | |
| 49 | \$3 and \$6 per ton..... | \$4 and \$7 per ton..... | \$3 to \$3.50 per ton for hemlock, \$5 to \$7 per ton for oak. | 10 years. |
| 50 | \$5 per cord..... | \$5.25 per cord..... | \$3.25 to \$5.25 per cord. | 50 years. |
| 51 | \$4.50 to \$5 per cord..... | \$5.50 to \$6 per cord..... | \$3.50 to \$6 per cord..... | 10 years. |
| 52 | \$4.50 per cord..... | \$4.50 per cord..... | | |
| 53 | \$5.50 per ton..... | \$6 per ton..... | \$5 to \$7.50 per ton..... | |
| 54 | \$7 per ton..... | \$7 per ton..... | | 10 to 15 years. |
| 55 | \$6.50 per ton..... | \$6.25 per ton..... | \$6.25 to \$6.75 per ton.. | 15 to 20 years. |
| 56 | do..... | \$7.25 per ton..... | \$6 to \$8 per ton..... | 10 to 15 years. |
| 57 | \$7.50 per ton..... | \$8 per ton..... | | |
| 58 | \$8 per ton..... | \$8.50 per ton..... | | |
| 59 | \$7.50 per ton..... | \$7.50 per ton..... | \$5 to \$8.50 per ton..... | 20 years. |
| 60 | \$8.90 per ton..... | \$8.75 to \$9 per ton..... | \$5 to \$11 per ton..... | |
| 61 | \$7 per ton..... | \$7 per ton..... | | 10 years. |
| 62 | | | Average \$4.25 per cord | 20 years. |
| 63 | \$4 per cord..... | \$4 per cord..... | \$3.50 to \$4 per cord.... | 25 to 30 years. |
| 64 | do..... | do..... | | 15 years. |
| 65 | \$4.25 per cord..... | \$4.25 per cord..... | \$3 to \$4.25 per cord.... | 15 to 20 years. |
| 66 | \$4 per cord..... | \$5.50 per cord..... | \$3.50 to \$5.50 per cord. | |
| 67 | \$4.50 to \$5 per cord..... | \$6 per cord..... | \$4 to \$6 per cord..... | 6 to 8 years. |
| 68 | \$4.25 per cord..... | \$5.25 per cord..... | \$3.50 to \$5.25 per cord. | Few years. |
| 69 | \$4.50 per cord..... | \$5.50 per cord..... | \$3 to \$5.50 per cord.... | 6 years. |
| 70 | \$4.50 per cord..... | \$6 per cord..... | \$4.50 to \$6 per cord.... | 10 years. |
| 71 | \$7 per cord..... | \$7 per cord..... | | |
| 72 | \$7 per cord..... | | \$7 to \$12 per cord..... | |
| 73 | \$6.50 and \$7.35..... | \$6.50 to \$7.35 per cord. | | |
| 74 | \$5.50 per cord..... | \$5.50 per cord..... | \$4.50 to \$7 per cord.... | 12 to 15 years. |
| 75 | \$10.50 per cord..... | \$11 per cord..... | \$9 to \$13 per cord..... | |
| 76 | \$3.75 per cord..... | \$4 per cord..... | | 30 years. |
| 77 | \$5.50 per ton..... | \$6.50 per ton..... | \$5.50 to \$6.50 per ton.. | 5 to 15 years. |
| 78 | \$5 per ton..... | \$6 per ton..... | \$5 to \$6 per ton..... | 25 to 30 years. |
| 79 | \$6 per ton..... | \$6.50 per ton..... | \$4.70 to \$6.50 per ton.. | 2 to 3 years. |
| 80 | \$6 per ton..... | \$6.50 per ton..... | \$4.50 to \$6.50 per ton.. | 5 to 30 years. |
| 81 | \$5 per ton..... | \$5.50 per ton..... | \$5 to \$7 per ton..... | 20 years. |
| 82 | \$7.10 per ton..... | \$7.75 per ton..... | | 6 years. |
| 83 | \$9 per ton..... | \$9.50 per ton..... | | 10 years. |
| 84 | \$8.25 per ton..... | \$8.75 per ton..... | \$6 to \$9 per ton..... | |
| 85 | \$5.50 per cord..... | \$5.50 per cord..... | \$5 to \$7 per cord..... | 4 to 5 years. |
| 86 | \$6 per cord..... | \$7 per cord..... | \$5 to \$7 per cord..... | 5 years. |
| 87 | \$7 per cord..... | \$7 per cord..... | \$5 to \$10 per cord..... | 5 years. |
| 88 | \$2.50 to \$3 and \$4.50 per cord. | \$2.50 to \$3 and \$4.50 per cord. | | 20 to 30 years. |
| 89 | \$6 per cord..... | \$7 per cord..... | \$4 to \$7 per cord..... | 10 years. |
| 90 | \$6.50 per cord..... | \$7 per cord..... | \$4 to \$7 per cord..... | 20 years. |
| 91 | \$3 per cord..... | \$4 per cord..... | \$3 to \$4 per cord..... | 10 years. |
| 92 | | \$6.50 per ton..... | | 10 to 15 years. |
| 93 | \$5.50 per cord..... | \$6.25 per cord..... | \$5 to \$8.37 per cord.... | 20 to 30 years. |
| 94 | \$6.50 per ton..... | \$6.50 per ton..... | \$6.50 per ton..... | About gone. |

(Table continued.)

PENNSYLVANIA.

| Number. | Counties. | Kinds of bark used. | Quantities used. | | Yield of bark per acre. |
|---------|----------------|----------------------------------|--|--------------------------------------|-------------------------|
| | | | 1880. | 1881 (estimated). | |
| 95 | Juniata | Rock and black oak | 206 cords | 250 cords | 5 cords |
| 96 | do | Chestnut oak | 90 tons | None | 2 to 15 tons |
| 97 | do | Rock oak | | | |
| 98 | Lackawanna | Hemlock and oak | 3,500 tons ¹ | 3,500 tons | 5 to 15 tons |
| 99 | do | do | 2,965 tons | | 10 tons |
| 100 | Lancaster | Rock and black oak | 100 cords | 100 cords | |
| 101 | do | Hemlock | | | |
| 102 | do | Chestnut oak | 75 tons ¹ | | |
| 103 | do | Oak and hemlock | 360 tons ¹ | 420 tons | |
| 104 | do | Rock oak | 800 tons ¹ | 800 tons | |
| 105 | do | Chestnut oak | 200 tons ¹ | 300 tons | |
| 106 | do | Chestnut oak and hemlock | 150 tons ¹ | 150 tons | |
| 107 | do | Chestnut oak | 125 tons ¹ | 125 tons | |
| 108 | do | do | 500 tons ¹ | 500 tons | |
| 109 | Lawrence | Hemlock and oak | 60 cords | 60 cords | |
| 110 | Lehigh | Chestnut oak | 75 cords | | |
| 111 | do | Oak | 250 tons ¹ | 250 tons | |
| 112 | do | Chestnut, red, and black oak. | 250 tons | 250 tons | 6 to 8 tons |
| 113 | do | Oak | 75 cords | 60 cords | |
| 114 | do | Chestnut oak | 200 tons ² | 200 tons | 300 tons |
| 115 | Luzerne | Hemlock and oak | 390 cords | 400 cords | 8 cords |
| 116 | do | do | 1,200 tons ¹ | 1,200 tons | 10 tons |
| 117 | do | Hemlock | 1,900 tons ¹ | 2,000 tons | 7 tons |
| 118 | do | Rock oak | | | 6 cords |
| 119 | do | Hemlock and oak | 1,650 tons ¹ | 1,650 tons | 10 to 12 tons |
| 120 | Lycoming | do | 500 tons ¹ | 500 tons | 10 to 30 cords |
| 121 | do | Oak | 200 cords | 200 cords | |
| 122 | do | Hemlock | 3,000 cords | 3,000 cords | |
| 123 | do | Hemlock and oak | 1,500 tons | 2,000 tons | 10 cords |
| 124 | do | Chestnut oak | 60 to 65 cords | 75 to 80 cords | |
| 125 | do | Hemlock | 3,800 tons ² | 6,000 tons | 12 cords |
| 126 | do | do | 5,000 cords | 5,000 tons | 8 cords |
| 127 | do | Hemlock and oak | 20 cords | 30 cords | |
| 128 | do | Hemlock | 5,000 cords | 5,000 cords | 10 cords |
| 129 | do | Hemlock and oak | 2,000 tons oak and 10,000 tons hem. | 2,000 tons oak & 10,000 tons hem. | |
| 130 | do | do | 243 cords ¹ | 243 cords | 10 cords |
| 131 | McKean | Hemlock | 4,000 cords ³ | 5,000 cords | 7 to 8 cords |
| 132 | do | do | 150 cords | 150 cords | |
| 133 | Mifflin | Oak and hemlock | 50 cords | | |
| 134 | Monroe | Hemlock and oak | 2,800 tons ¹ | | |
| 135 | do | do | 1,200 tons ¹ | 1,200 tons | |
| 136 | do | do | 3,000 tons ¹ | 3,000 tons | 1 to 15 tons |
| 137 | Montgomery | Chestnut oak | 8 tons ¹ | | |
| 138 | do | Chestnut oak and hemlock | 125 tons ¹ | 125 tons | |
| 139 | do | Chestnut, black, and Spanish oak | 50 cords | 50 cords | 5 cords |
| 140 | do | Oak and hemlock | 180 tons ¹ | 200 tons | |
| 141 | Montour | Oak | 30 cords | 30 cords | 20 to 30 cords |
| 142 | do | Oak and hemlock | 60 cords | 60 cords | |
| 143 | do | do | 65 tons | 80 tons | 10 tons |
| 144 | Northampton | Chestnut and white oak | 50 tons ¹ | 60 tons | |
| 145 | Northumberland | Chestnut oak | 60 tons | 60 tons | 5 tons |
| 146 | do | do | 40 cords | 40 cords | 5 to 20 cords |
| 147 | do | Oak and hemlock | 2,350 tons ¹ | 2,000 tons | 4 to 5 tons |
| 148 | do | do | 100 tons ¹ | 70 tons | 6 to 10 tons |
| 149 | do | Oak | 40 tons ¹ | 40 tons | 5 tons |
| 150 | do | Chestnut oak | 15 cords | 12 cords | 10 to 15 cords |
| 151 | Perry | do | 2,500 tons ¹ | 3,800 tons | 3 tons |
| 152 | do | Oak | 2,300 tons ¹ | 2,300 tons | 2 to 12 tons |
| 153 | do | Chestnut oak | 75 cords | 300 tons ¹ | 10 tons |
| 154 | do | do | 100 tons ¹ | 100 tons | |
| 155 | Philadelphia | Chestnut, Spanish and black oak | 60 tons ² | 100 tons | |
| 156 | do | Chestnut oak and sumac | { 5 tons oak ² . 4 tons sumac. | { 6 tons oak. 8 tons sumac. | |
| 157 | do | Chestnut and Spanish oak | 1,000 tons ¹ | 1,000 tons | |

¹ Specified as 2,000 pounds.² Specified as 2,240 pounds.³ Specified as 2,200 pounds.

returns by States.

(Table continued.)

PENNSYLVANIA.

| Number. | Price of bark. | | | Estimated duration of bark supply. |
|---------|---|---|-----------------------------|------------------------------------|
| | 1880. | 1881. | Range of prices since 1870. | |
| 95 | \$5 per cord | \$6 per cord | \$4 to \$8 per cord | 50 years. |
| 96 | \$5.50 per ton | | | 30 years. |
| 97 | \$5 per ton | | | 100 years. |
| 98 | \$6 per ton | \$6 per ton | | 10 years. |
| 99 | \$6 per ton | \$6.50 per ton | \$5 to \$6.50 per ton | About gone. |
| 100 | \$9 per cord | \$10 per cord | \$9 to \$10 per cord | |
| 101 | \$4.25 to \$6 per cord | | | |
| 102 | \$9 per ton | | | About gone. |
| 103 | { \$7 per ton, hemlock \$9 per ton, oak } | { \$7.75 per ton, hemlock \$10.50 per ton, oak } | | Few years. |
| 104 | \$10 per ton | \$10 per ton | \$8.50 to \$12 per ton | Limited. |
| 105 | \$10 per ton | \$10.50 per ton | \$8 to \$11 per ton | |
| 106 | \$10 to \$12 per ton | \$9 to \$11 per ton | \$9 to \$15 per ton | |
| 107 | \$9.50 per ton | \$10 per ton | \$8 to \$10 per ton | |
| 108 | \$10 per ton | \$10.50 per ton | \$8 to \$11 per ton | |
| 109 | \$7.50 per cord | \$9.50 per cord | \$7.50 to \$9 per cord | |
| 110 | \$7 per cord | \$7 per cord | | |
| 111 | \$9 per ton | \$9 per ton | \$8 to \$9 per ton | |
| 112 | \$8 per ton | \$8 per ton | | 15 to 25 years. |
| 113 | \$5 per cord | \$7 per cord | \$5 to \$7 per cord | Many years. |
| 114 | \$9 per ton | \$9 per ton | \$7.50 to \$12 per ton | About gone. |
| 115 | \$5 per cord | \$6 per cord | \$4.50 to \$6 per cord | Short time. |
| 116 | \$4.50 per ton | \$4.50 per ton | \$4 to \$4.50 per ton | 25 to 30 years. |
| 117 | \$4 per ton | \$5 per ton | \$3.50 to \$5 per ton | 5 years. |
| 118 | \$6 per cord | \$6 per cord | \$5 to \$8 per cord | 20 years. |
| 119 | \$6.25 per ton | \$7 per ton | | 10 to 12 years. |
| 120 | \$6 per ton | \$7.50 per ton | \$6 to \$7.50 per ton | 10 years. |
| 121 | \$7 per cord | \$9 per cord | | 10 to 12 years. |
| 122 | \$5.50 to \$6.50 per cord | \$5.50 to 6.50 per cord | | 7 to 10 years. |
| 123 | \$5 50 per ton | \$5 per cord | \$4.25 to \$5.50 per ton | 20 years. |
| 124 | \$6 per cord | \$9 per cord | | 10 years. |
| 125 | \$3.50 per cord | \$3.50 per cord | \$3.50 to \$4 per cord | 20 years. |
| 126 | \$4 per cord | \$4 per ton | \$2.50 to \$4 per cord | 25 years. |
| 127 | \$6.50 per cord | \$7 per cord | \$5 to \$7 per cord | Many years. |
| 128 | \$5.25 per cord | \$5 per cord | \$4.50 to \$5.25 per cord | 15 years. |
| 129 | { \$6.25 per cord hemlock ³ \$7 per cord oak ³ } | { \$6 per cord hemlock ³ \$8.50 per cord oak ³ } | | |
| 130 | \$7 per cord | \$8 per cord | | 5 years. |
| 131 | \$4 per cord | \$5 per cord | \$3.50 to \$5 per cord | 20 years. |
| 132 | \$4.25 per cord | \$4.50 per cord | \$4 to \$4.50 per cord | 40 years. |
| 133 | \$6 per cord | \$6.50 per cord | | 50 to 100 years. |
| 134 | \$6 per ton | \$6.50 per ton | | 10 years. |
| 135 | \$7.50 per ton | \$7.50 per ton | | |
| 136 | \$7.50 per ton | \$7.50 per ton | | 4 to 5 years. |
| 137 | \$6.50 to \$8 per ton | \$6.50 to \$8 per ton | | |
| 138 | \$10 per ton | \$10.50 per ton | \$8.25 to \$12 per ton | |
| 139 | \$7.66 $\frac{2}{3}$ per cord | \$7.66 $\frac{2}{3}$ per cord | | 15 years. |
| 140 | \$9 per ton | \$9 per ton | \$7.50 to \$9 per ton | |
| 141 | \$7 per cord | \$7.50 per cord | \$7 to \$8.50 per cord | 20 years. |
| 142 | \$6 per cord | \$6 per cord | \$6 to \$7 per cord | |
| 143 | \$7 per cord | \$8 per ton | \$5 to \$8 per ton | 15 years. |
| 144 | \$7 per ton | \$7 per ton | \$6 to \$9 per ton | 10 years. |
| 145 | \$7 per ton | \$7 per ton | \$4 to \$7 per ton | 50 years. |
| 146 | \$7 per cord | \$8 per cord | \$5 to \$8 per cord | |
| 147 | { \$8.25 per ton for oak \$6.25 per ton, hemlock } | { \$8.25 per ton for oak \$6.25 per ton, hemlock } | \$5 to \$9.50 per ton, oak | 10 years. |
| 148 | \$7 per ton | \$7.50 per ton | \$5.50 to \$9 per ton | 10 years. |
| 149 | \$7 per ton | \$7 per ton | \$5 to \$8 per ton | 50 years. |
| 150 | \$6 per cord | \$7 per cord | \$5 to \$9 per cord | 20 years. |
| 151 | \$8 per ton | \$9 per ton | | 10 years. |
| 152 | \$8 per ton | \$8.50 per ton | \$6 to \$9 per ton | 10 to 15 years. |
| 153 | \$5 per ton | \$6.50 per ton | \$5.50 to \$7 per ton | 20 years. |
| 154 | \$7 per ton | \$7.50 per ton | \$5 to \$8.50 per ton | 25 years. |
| 155 | \$20 per ton | \$20 per ton | | |
| 156 | { \$25 per ton for oak \$52 per ton for sumac } | { \$24 per ton for bark \$45 per ton for sumac } | | |
| 157 | \$9 per ton | \$11 per ton | \$8 to \$15 per ton | |

(Table continued.)

PENNSYLVANIA.

| Number. | Counties. | Kinds of bark used. | Quantities used. | | Yield of bark per acre. |
|---------|-----------------|--------------------------------------|----------------------------------|-------------------------------|-------------------------|
| | | | 1880. | 1881 (estimated). | |
| 158 | Pike | Hemlock, birch, and oak .. | 1,500 cords | 1,500 tons ¹ | 5 to 10 cords .. |
| 159 | ..do | Hemlock and rock oak | 600 cords | 600 cords | 1½ to 10 cords .. |
| 160 | ..do | Oak | 350 tons ¹ | 350 tons | 10 tons |
| 161 | ..do | Chestnut, red, pin, and black oak .. | 200 tons | 240 tons | 2 tons |
| 162 | Schuylkill .. | Oak and hemlock | 125 tons | 125 tons | 1 to 5 tons |
| 163 | ..do | Rock oak | 150 tons | 175 tons | 3 tons |
| 164 | ..do | Chestnut oak | 800 tons ¹ | 800 tons | 6 tons |
| 165 | ..do | ..do | 600 tons ¹ | 600 tons | 3 tons |
| 166 | Snyder | ..do | 100 cords | 100 cords | 5 cords |
| 167 | Somerset | Chestnut oak and spruce .. | 135 cords | 135 cords | 2 cords |
| 168 | ..do | Rock and black oak | 10-15 cords | 10 to 15 cords .. | 10 cords |
| 169 | ..do | Chestnut oak | 50 cords | 70 cords | 4 cords |
| 170 | ..do | ..do | 100 cords | 100 cords | 10 to 15 cords .. |
| 171 | Sullivan | Hemlock | 5,000 cords ² | 10,000 cords | 7 cords |
| 172 | ..do | Hemlock and rock oak | 7,250 cords | 8,000 cords | 10 to 15 cords .. |
| 173 | Susquehanna .. | Hemlock | 2,500 tons ¹ | 2,500 cords | 13 tons |
| 174 | ..do | ..do | 2,500 tons ¹ | 2,500 cords | 6 to 8 tons |
| 175 | ..do | Hemlock and oak | 2,000 tons ¹ | 2,000 cords | 10 tons |
| 176 | ..do | Hemlock | 2,700 tons ¹ | 2,700 cords | 10 to 30 tons .. |
| 177 | ..do | ..do | 2,500-2,800 tons ¹ .. | 2,500 cords | 10 tons |
| 178 | ..do | ..do | 200 tons ¹ | 200 cords | .. |
| 179 | ..do | ..do | 3,000 tons ¹ | .. | 15 tons |
| 180 | Tioga | Hemlock and oak | 308 cords | 308 cords | 5 to 20 cords .. |
| 181 | ..do | Hemlock | 10,750 cords ³ | 10,000 cords | 5 cords |
| 182 | ..do | ..do | 9,000 cords | 9,000 cords | 8 cords |
| 183 | ..do | ..do | 7,000 cords | 8,000 cords | .. |
| 184 | ..do | ..do | 2,500 cords ³ | 2,500 cords | .. |
| 185 | ..do | ..do | 5,000-6,000 cords | 5,000-6,000 cords .. | 6 to 10 cords .. |
| 186 | ..do | Hemlock and oak | .. | 1,000 cords | .. |
| 187 | ..do | Hemlock | 400 cords | 500 cords | 12 cords |
| 188 | Union | Chestnut oak | 75 tons ² | 100 tons | .. |
| 189 | Venango | Hemlock and oak | 20 cords | 20 cords | .. |
| 190 | ..do | ..do | 75 cords ² | 85 cords | 12 tons |
| 191 | Warren | Hemlock | 7,200 cords | 8,000-10,000 cords | 7 to 10 cords .. |
| 192 | ..do | ..do | .. | .. | 25 to 50 cords .. |
| 193 | ..do | ..do | 2,000 cords | .. | .. |
| 194 | ..do | ..do | 1,300 cords | 1,300 cords | 10 cords |
| 195 | ..do | ..do | 7,000 cords | 8,000-9,000 cords .. | 6 to 10 cords .. |
| 196 | ..do | ..do | 500 to 600 cords | 280 cords | 25 cords |
| 197 | Washington .. | Chestnut, black, and white oak .. | 50 cords | 50 cords | .. |
| 198 | Wayne | Hemlock | 4,300 cords | 3,000 cords | 8 cords |
| 199 | ..do | ..do | 1,800 cords | 1,800 cords | 15 cords |
| 200 | ..do | ..do | 300 cords ³ | 2,000 cords | 8 cords |
| 201 | ..do | ..do | 3,000 cords | 5,000 cords | 5 to 15 cords .. |
| 202 | ..do | ..do | 4,500 tons ¹ | 4,500 tons | 8 cords |
| 203 | Westmoreland .. | Chestnut, black, and white oak .. | 50 cords | 65 cords | About gone |
| 204 | ..do | Chestnut oak | 600 cords | 700 cords | .. |
| 205 | ..do | Rock oak | 25 cords | .. | .. |
| 206 | Wyoming | Hemlock | 315 tons ¹ | 315 tons | .. |
| 207 | ..do | Hemlock and oak | 6,500 tons ¹ | 7,000 tons | 8 to 10 tons |
| 208 | ..do | ..do | 70 tons ¹ | 75 tons | .. |
| 209 | ..do | ..do | 60 tons ¹ | 60 tons | .. |
| 210 | ..do | ..do | 4,000 tons | 4,400 tons | .. |
| 211 | York | Chestnut oak | 70 tons ¹ | 100 tons | 15 tons |
| 212 | ..do | ..do | 100 tons ¹ | 100 tons | 14 tons |
| 213 | ..do | Chestnut and Spanish oak .. | 150 cords | 140 cords | 10 to 15 cords .. |
| 214 | Blair* | Rock oak and hemlock | 4,000 tons | 4,000 tons | .. |
| 215 | Cumberland* .. | Oak | 30 tons ¹ | .. | .. |

*Received too late for insertion in proper place.

¹Specified as 2,000 pounds.³Specified as 2,200 pounds.

returns by States.

(Table continued.)

PENNSYLVANIA.

| Number. | Price of bark. | | | Estimated duration of bark supply. |
|---------|--------------------------------------|--------------------------------|--------------------------------|------------------------------------|
| | 1880. | 1881. | Range of prices since 1870. | |
| 153 | \$7 per cord..... | \$7 per cord..... | \$5 to \$7 per cord..... | 1 year. |
| 159 | \$5 per cord..... | \$5 per cord..... | \$5 per cord..... | About gone. |
| 160 | \$5 per ton..... | \$6.50 per ton..... | \$6.50 to \$11 per ton..... | 10 years. |
| 161 | \$6 per ton..... | \$6 per ton..... | \$5 to \$6 per ton..... | 10 years. |
| 162 | \$8 per ton..... | \$7.50 per ton..... | \$8 to \$10 per ton..... | 5 to 10 years. |
| 163 | \$7 per ton..... | \$7 per ton..... | \$5 to \$9 per ton..... | 20 to 40 years. |
| 164 | \$9 per ton..... | \$9 per ton..... | \$6.50 to \$11 per ton..... | 20 years. |
| 165 | \$9 per ton..... | \$9 per ton..... | | 10 years. |
| 166 | \$6 per cord..... | \$7 per cord..... | \$4 to \$7 per cord..... | 40 to 50 years. |
| 167 | \$4 per cord..... | \$5 per cord..... | \$4 to \$5 per cord..... | 20 years. |
| 168 | \$7 per cord..... | \$7 per cord..... | \$7 per cord..... | 100 years. |
| 169 | \$5 per cord..... | \$6 per cord..... | \$3.50 to \$6 per cord..... | 15 to 20 years. |
| 170 | \$6 per cord..... | \$6 per cord..... | \$5 to \$6 per cord..... | 10 years. |
| 171 | | | | |
| 172 | \$4 per cord..... | \$4.25 per cord..... | | 25 years. |
| 173 | \$6 per ton..... | | | |
| 174 | \$6 per ton..... | \$6 per ton..... | \$4.50 to \$6 per ton..... | 2 years. |
| 175 | \$6 per ton..... | \$6 per ton..... | \$4.50 to \$6 per ton..... | 15 to 20 years. |
| 176 | \$5 to \$5.50 per ton..... | \$5.50 to \$6 per ton..... | | 8 to 10 years. |
| 177 | \$6 per ton..... | \$6 per ton..... | \$4.50 to \$6 per ton..... | 5 years. |
| 178 | \$6.50 per ton..... | \$6 per ton..... | \$5 to \$7 per ton..... | 20 years. |
| 179 | \$3.50 per ton..... | \$6 per ton..... | \$5 to \$6.50 per ton..... | 5 years. |
| 180 | \$4 per cord..... | \$4 per cord..... | \$3 to \$4 per cord..... | 15 years. |
| 181 | \$4.50 per cord..... | \$4.75 per cord..... | \$4 to \$4.75 per cord..... | 15 to 20 years. |
| 182 | \$5 per cord..... | \$5 per cord..... | | 50 years. |
| 183 | \$5 per cord..... | \$5 per cord..... | \$4.50 to \$5 per cord..... | 15 years. |
| 184 | \$5.50 per cord..... | \$5.50 per cord..... | \$4.25 to \$5.50 per cord..... | |
| 185 | \$5 per cord..... | \$5 per cord..... | \$4 to \$5 per cord..... | 10 years. |
| 186 | \$4 per cord..... | \$4 per cord..... | \$3.50 to \$4 per cord..... | 20 years. |
| 187 | \$4.25 per cord..... | \$4.50 per cord..... | \$3.75 to \$4.50 per cord..... | 25 years. |
| 188 | \$7 per ton..... | \$7.50 per ton..... | \$6 to \$8 per ton..... | 10 years. |
| 189 | \$5 to \$6 per cord..... | \$5 to \$6 per cord..... | | |
| 190 | \$6 per cord..... | \$7 per cord..... | | 10 years. |
| 191 | \$4.50 per cord..... | \$5.50 per cord..... | \$3.50 to \$5.50 per cord..... | 15 years. |
| 192 | \$4 per cord..... | \$4.75 to \$5.50 per cord..... | | 15 years. |
| 193 | \$4.50 per cord..... | \$4.75 per cord..... | | 10 years. |
| 194 | \$4.50 per cord..... | \$5.75 per cord..... | \$3.50 to \$4 per cord..... | 10 years. |
| 195 | \$4.50 to \$5 per cord..... | \$5.25 per cord..... | | 8 to 10 years. |
| 196 | \$4.50 per cord..... | \$5 per cord..... | | 10 years. |
| 197 | \$7 per cord..... | \$7 per cord..... | \$7 to \$8 per cord..... | Many years. |
| 198 | \$5 per cord..... | \$5.50 per cord..... | | 4 to 5 years. |
| 199 | \$5 per cord..... | \$6 per cord..... | \$4.50 to \$6.50 per cord..... | 5 years. |
| 200 | \$6 per cord..... | \$6.25 per cord..... | \$5 to \$7 per cord..... | 3 years. |
| 201 | \$5 per cord..... | \$5 per cord..... | | 10 years. |
| 202 | \$5.25 per ton..... | \$5.50 per ton..... | \$4 to \$5.50 per ton..... | 5 to 6 years. |
| 203 | \$7 per cord..... | \$7 per cord..... | | 10 years. |
| 204 | \$10.50 per cord..... | \$10.75 per cord..... | | 5 years. |
| 205 | \$7 per cord..... | \$8.50 per cord..... | \$5 to \$8.50 per cord..... | 30 years. |
| 206 | \$6.50 per ton..... | \$6 per ton..... | | 5 to 10 years. |
| 207 | \$5.75 per ton..... | \$6.25 per ton..... | \$4.50 to \$6.25 per ton..... | 20 years. |
| 208 | \$3 and \$6 per ton..... | \$5.75 and \$6 per ton..... | \$3.50 to \$5 per ton..... | 15 years. |
| 209 | \$5.50 per ton..... | \$5.50 per ton..... | \$3.50 to \$5.50 per ton..... | 10 to 15 years. |
| 210 | \$5 per ton..... | \$5.50 per ton..... | \$4 to \$5.50 per ton..... | 20 years. |
| 211 | \$6 per ton..... | \$6 per ton..... | | 50 years. |
| 212 | \$8 per ton..... | \$9 per ton..... | Average \$8 per ton..... | 6 years. |
| 213 | \$5 per cord..... | \$4.75 per cord..... | | 25 to 40 years. |
| 214 | \$7 per ton..... | \$7.25 per ton..... | \$6 to \$7.25 per ton..... | 15 years. |
| 215 | \$7 to \$8 per ton..... ² | \$7 to \$8 per ton..... | \$6 to \$10 per cord..... | 10 to 15 years. |

² Specified as 2,240 pounds.

(22.) SOUTH CAROLINA.

| Number. | Counties. | Kinds of bark used. | Quantities used. | | Yield of bark per acre. |
|---------|-------------------|--|-----------------------|-------------------|-------------------------|
| | | | 1880. | 1881 (estimated). | |
| 1 | Abbeville..... | Red, black, and white oak. | | | 4 to 5 cords |
| 2 | Chesterfield..... | Red and black oak | 40 cords | 50 cords | 2 to 3 cords |
| 3 | Greenville..... | do | 150 cords | 200 cords | |
| 4 | do | Chestnut, red, black, and Spanish oak. | 75 cords ¹ | 150 cords | 5 to 6 cords |
| 5 | Oconee..... | Black and red oak | 125 cords | | 5 cords |
| 6 | do | Red oak | 25 cords | 25 cords | 4 cords |
| 7 | do | Red, black, Spanish, and white oak. | 150 cords | 150 cords | 1 cord |
| 8 | York..... | Black and red oak | 40 cords | 40 cords | |

¹Specified as 2,240 pounds.

(23.) TENNESSEE.

| | | | | | |
|----|-----------------|------------------------------------|-----------------------|------------------------|----------------|
| 1 | Anderson..... | Chestnut, white, and black oak | 3 cords | | 10 cords |
| 2 | Bedford..... | Chestnut oak | 60 cords | 60 cords | |
| 3 | Blount..... | Chestnut and black oak | | 100 cords | |
| 4 | Campbell..... | Chestnut, white, and black oak | | 30 cords | 4 cords |
| 5 | Davidson..... | Chestnut oak | 1,000 cords | 1,400 cords | |
| 6 | Dickson..... | Black and chestnut oak | 25 cords | 30 to 40 cords | 10 to 15 cords |
| 7 | Grainger..... | Chestnut, black, and white oak | 15 cords | 12 cords | |
| 8 | Hamilton*..... | Chestnut oak | 20,000 cords | 25,000 to 27,000 cords | |
| 9 | do | do | | 500 cords | |
| 10 | Humphreys..... | do | 60 cords ¹ | 60 cords | 10 cords |
| 11 | Jackson..... | Chestnut and black oak | 20 cords | None | 10 to 15 cords |
| 12 | Knox..... | do | 50 cords | 75 cords | |
| 13 | do | Chestnut oak | 200 cords | 250 cords | |
| 14 | do | Chestnut and black oak | 600 cords | 600 cords | |
| 15 | do | do | 100 cords | 100 cords | 5 to 6 cords |
| 16 | Lawrence..... | Chestnut oak | 25 cords | 25 cords | 3 cords |
| 17 | Lincoln..... | do | 50 cords | 50 cords | |
| 18 | London..... | Black, red, chestnut and white oak | 100 cords | 150 cords | 20 cords |
| 19 | McMinn..... | Chestnut oak | 40 cords | 50 cords | |
| 20 | Madison..... | Black, red, and Spanish oak | 80 to 100 cords | 80 to 100 cords | 8 to 12 cords |
| 21 | Maury..... | Chestnut oak | 30 cords | 30 cords | 3 cords |
| 22 | Moore..... | do | 35 cords | 40 cords | 3 cords |
| 23 | do | do | 30 cords | 30 cords | 5 cords |
| 24 | Perry..... | do | 800 cords | 800 cords | 3 to 5 cords |
| 25 | Sullivan..... | Chestnut and black oak | 35 to 40 cords | | |
| 26 | Warren..... | Chestnut oak | 175 cords | 175 to 200 cords | 1 to 5 cords |
| 27 | Washington..... | do | 40 cords | 40 cords | |
| 28 | Wayne..... | do | 50 cords ¹ | 75 cords | 1 cord |

*This return includes a radius of from 25 to 30 miles about Chattanooga.

¹Specified as 2,000 pounds.

(24.) TEXAS.

| | | | | | |
|---|---------------|----------------------------------|-----------|--------------------------------|----------------|
| 1 | Cass..... | White, red, black, and post oak. | 110 cords | 180 cords | 6 cords |
| 2 | De Witt..... | Black and live oak | 37 cords | | |
| 3 | Harrison..... | Red, white, and black oak | 50 cords | 75 cords | 10 to 15 cords |
| 4 | Kendall..... | Sumac and cedar tops | | { 3½ tons sumac ¹ } | |
| 5 | Lemar..... | Black, red, and Spanish oak | None | { 5 tons cedar } | |
| 6 | Waller..... | Red oak | 200 cords | 30 to 40 cords | 2 to 3 cords |
| | | | | 200 cords | |

¹Specified as 2,240 pounds.

returns by States.

SOUTH CAROLINA.

| Number. | Price of bark. | | | Estimated duration of bark supply. |
|---------|--------------------------|--------------------------|--------------------------------|------------------------------------|
| | 1880. | 1881. | Range of prices since 1870. | |
| 1 | \$6 per cord..... | | | 50 years. |
| 2 | \$6 per cord..... | \$6 per cord..... | \$6 per cord..... | Many years. |
| 3 | | | | |
| 4 | \$5 per cord..... | \$5 per cord..... | \$4.50 to \$5 per cord..... | Many years. |
| 5 | \$3 per cord..... | \$3 per cord..... | \$3.50 to \$4.50 per cord..... | 20 years. |
| 6 | \$3.50 per cord..... | \$3.50 per cord..... | \$3 to \$4.50 per cord..... | 10 years. |
| 7 | \$3.50 per cord..... | \$3.50 per cord..... | \$3 to \$3.50 per cord..... | Many years. |
| 8 | \$4 to \$5 per cord..... | \$4 to \$5 per cord..... | | 25 to 30 years. |

TENNESSEE.

| | | | | |
|----|-----------------------------|-----------------------------|------------------------------|-----------------|
| 1 | \$6 per cord..... | \$6 per cord..... | \$3 to \$6 per cord..... | Several years. |
| 2 | \$5.50 per cord..... | \$5 to \$5.25 per cord..... | \$5 to \$8 per cord..... | |
| 3 | \$5 per cord..... | \$2.50 to \$5 per cord..... | | 5 years. |
| 4 | \$5 to \$6 per cord..... | \$5 to \$6 per cord..... | \$2.50 to \$6 per cord..... | 50 years. |
| 5 | \$10 per cord..... | \$11 per cord..... | \$10 to \$12 per cord..... | 25 years. |
| 6 | \$4 per cord..... | \$4.50 per cord..... | \$2.50 to \$10 per cord..... | 5 to 6 years. |
| 7 | \$2.50 to \$3 per cord..... | \$2.50 to \$3 per cord..... | \$2.50 to \$3 per cord..... | Many years. |
| 8 | \$6 to \$6.50 per cord..... | \$6.50 to \$8 per cord..... | | Many years. |
| 9 | \$6 per cord..... | \$7 per cord..... | | Few years. |
| 10 | \$5 per cord..... | \$5 per cord..... | \$5 per cord..... | |
| 11 | \$4 per cord..... | \$4 per cord..... | \$4 per cord..... | Many years. |
| 12 | \$4 per cord..... | \$4 per cord..... | | 3 years. |
| 13 | | \$4 per cord..... | \$4 to \$6 per cord..... | |
| 14 | \$5 per cord..... | \$3 to \$6 per cord..... | \$5 to \$6 per cord..... | |
| 15 | \$3 per cord..... | \$3 per cord..... | \$3 per cord..... | Always. |
| 16 | \$5 per cord..... | \$5 per cord..... | \$5 per cord..... | Always. |
| 17 | do..... | \$5 per cord..... | \$5 per cord..... | 10 years. |
| 18 | \$3.50 per cord..... | \$3.50 per cord..... | \$3 to \$4.50 per cord..... | 50 years. |
| 19 | \$4.50 per cord..... | \$4.50 per cord..... | \$4.50 to \$5 per cord..... | 15 years. |
| 20 | \$4 to \$5 per cord..... | \$4 per cord..... | \$4 to \$5 per cord..... | 1,000 years. |
| 21 | \$5 per cord..... | \$5 per cord..... | \$5 per cord..... | 20 years. |
| 22 | \$5 per cord..... | \$5 per cord..... | | 100 years. |
| 23 | \$4 per cord..... | \$4 per cord..... | \$4 to \$5 per cord..... | 100 years. |
| 24 | \$4 per cord..... | \$4.50 per cord..... | \$3.50 to \$5 per cord..... | 6 years. |
| 25 | \$4 per cord..... | \$4 per cord..... | \$2.50 to \$4 per cord..... | 15 to 20 years. |
| 26 | \$6 per cord..... | \$6.50 per cord..... | \$4 to \$10 per cord..... | Always. |
| 27 | \$3 per cord..... | \$4 per cord..... | | Few years. |
| 28 | \$3 per cord..... | \$3 per cord..... | \$3 per cord..... | 20 years. |

(24.) TEXAS.

| | | | | |
|---|--------------------------|--------------------------|--------------------------|-----------------|
| 1 | \$3.50 per cord..... | \$3.50 per cord..... | | 10,000 years. |
| 2 | \$5 to \$6 per cord..... | \$5 to \$6 per cord..... | \$5 to \$6 per cord..... | 10 to 25 years. |
| 3 | \$3 per cord..... | \$3 per cord..... | \$3 per cord..... | 30 years. |
| 4 | \$6 per ton cedar..... | \$6 per ton cedar..... | \$6 per ton cedar..... | Always. |
| 5 | \$30 per ton sumac..... | \$30 per ton sumac..... | \$30 per ton sumac..... | |
| 6 | \$6 per cord..... | \$6 per cord..... | \$5 per cord..... | Always. |
| 7 | \$3 to \$4 per cord..... | \$3 to \$4 per cord..... | | Always. |

(25.) UTAH.

| Number. | Counties. | Kinds of bark used. | Quantities used. | | Yield of bark per acre. |
|---------|-----------------|----------------------|------------------|-------------------|-------------------------|
| | | | 1880. | 1881 (estimated.) | |
| 1 | Cache | Red pine | 12 cords | 13 cords | None here.... |
| 2 | Salt Lake | California oak | 100 cords | 100 cords | |
| 3 | San Pete | Red pine | 6 cords | 5 cords | |

(26.) VERMONT.

| | | | | | |
|----|------------------|-------------------------|-----------------------------|-------------------|----------------------|
| 1 | Addison | Hemlock and sumac | | | 100 cords |
| 2 | Caledonia | Hemlock | 150 cords | 200 cords | 10 cords |
| 3 | Franklin | do | 2 cords | 2 cords | |
| 4 | do | do | 200 cords shipped | 200 cords | 30 to 40 cords |
| 5 | do | do | 100 cords | 125 cords | 10 cords |
| 6 | do | do | 900 cords | 800 cords | 15 cords |
| 7 | do | do | 150 cords | 100 cords | 25 cords |
| 8 | Orange | do | 75 cords | 75 cords | |
| 9 | do | do | 88 cords | 100 cords | |
| 10 | do | do | 40 cords | 50 cords | |
| 11 | Rutland | do | 80 cords ¹ | 80 cords | |
| 12 | do | do | 100 cords | 100 cords | 10 cords |
| 13 | Washington | do | 80 cords | 90 cords | |
| 14 | do | do | 1,350 cords | 1,350 cords | 5 cords |
| 15 | Windham | do | 200 cords | 200 cords | |
| 16 | Windsor | do | 300 cords | 300 cords | |
| 17 | do | do | 100 cords | 100 cords | |

¹Specified as 2,000 pounds.

(27.) VIRGINIA.

| | | | | | |
|----|---------------------|---|-----------------------------|------------------------|----------------------|
| 1 | Amherst | Black, red, and Spanish oak | 27 cords | | 10 to 24 cords |
| 2 | do | Black, Spanish, and chestnut oak | 50 cords | 50 cords | 10 cords |
| 3 | Floyd | Chestnut and black oak | 20 cords | 25 cords | |
| 4 | Frederick | Chestnut oak | 160 cords | 180 cords | |
| 5 | do | do | 50 cords | 75 cords | 5 to 7 cords |
| 6 | Fauquier | Black and chestnut oak | 20 cords | 25 cords | |
| 7 | Henry | Chestnut, Spanish, and black oak | 40 cords | 40 cords | 10 cords |
| 8 | do | do | 150 cords | | 50 cords |
| 9 | Louisa | Black and chestnut oak | 50 cords | 100 cords | 5 cords |
| 10 | do | Red, black, Spanish, and chestnut oak | 20 cords | 40 cords | 5 cords |
| 11 | Loudoun | Black and rock oak | 40 cords | 40 cords | |
| 12 | Patrick | Chestnut oak | 20 cords | 20 cords | 20 cords |
| 13 | Pittsylvania | do | 200 tons ¹ | 300 tons | 3 cords |
| 14 | Rockbridge | Black and chestnut oak | 40 cords ² | 40 cords | |
| 15 | do | Chestnut oak | 10 to 15 cords | | |
| 16 | Rockingham | Chestnut and black oak | 85 tons ¹ | 85 tons | 10 to 40 tons |
| 17 | Scott | Chestnut oak | 30 cords | 40 cords | 20 cords |
| 18 | Shenandoah | Rock oak | 80 cords | 80 cords | 5 to 10 cords |
| 19 | do | Chestnut and Spanish oak | 2,000 cords | 3,000 cords | 4 to 20 cords |
| 20 | Smyth | do | 6 to 8 cords | 6 cords | |
| 21 | Spottsylvania | do | 500 to 700 cords | 500 to 700 cords | 10 to 50 cords |
| 22 | Warren | Chestnut oak | 2,700 cords | 3,100 cords | 4 cords |
| 23 | do | do | 100 cords | 100 cords | 5 to 15 cords |

¹Specified as 2,240 pounds.

(28.) WEST VIRGINIA.

| | | | | | |
|---|-----------------|--------------------------------------|-----------------------------|----------------|----------------------|
| 1 | Barbour | Chestnut oak | 80 cords | 80 cords | |
| 2 | Brooke | Chestnut and white oak | 75 cords | 75 cords | 2 cords |
| 3 | Cabell | Chestnut oak | 50 cords ¹ | | 5 cords |
| 4 | Doddridge | Chestnut, black, and white oak | 15 cords | 15 cords | 10 to 15 cords |

¹Specified as 60 feet.

returns by States.

(25.) UTAH.

| Number. | Price of bark. | | | Estimated duration of bark supply. |
|---------|--------------------|--------------------|-----------------------------|------------------------------------|
| | 1880. | 1881. | Range of prices since 1870. | |
| 1 | \$13 per cord..... | \$13 per cord..... | \$13 per cord..... | 10 years. |
| 2 | | | | |
| 3 | \$10 per cord..... | \$10 per cord..... | \$10 to \$25 per cord... | |

(26.) VERMONT.

| | | | | |
|----|----------------------------|----------------------------|-----------------------------|-----------------|
| 1 | \$3.50 per cord..... | \$3.50 per cord..... | | Always. |
| 2 | \$8 per cord..... | \$8 per cord..... | \$5 to \$8 per cord..... | 10 years. |
| 3 | \$6 per cord..... | \$6 per cord..... | | 20 years. |
| 4 | \$5 per cord..... | \$6 per cord..... | \$4 to \$6 per cord..... | |
| 5 | \$6 per cord..... | \$6.25 per cord..... | | |
| 6 | \$7.50 per cord..... | \$7.50 per cord..... | \$5 to \$7.50 per cord..... | Few years. |
| 7 | \$5.50 per cord..... | \$6.25 per cord..... | \$4 to \$6.25 per cord..... | 5 years. |
| 8 | \$6 per cord..... | \$6 per cord..... | \$3.50 to \$7 per cord..... | 20 years. |
| 9 | \$6.50 per cord..... | \$6.50 per cord..... | \$4 to \$7 per cord..... | 35 to 40 years. |
| 10 | \$6.50 per cord..... | \$6 per cord..... | | Many years. |
| 11 | \$8.75 to \$9 per cord.... | \$8.75 to \$9 per cord.... | | |
| 12 | \$5 per cord..... | \$6 per cord..... | \$5 to \$6 per cord..... | |
| 13 | \$6 per cord..... | \$6 per cord..... | | 10 years. |
| 14 | \$6 per cord..... | \$7 per cord..... | \$5 to \$7 per cord..... | 20 years. |
| 15 | \$7.25 per cord..... | \$7.25 per cord..... | \$5 to \$8 per cord..... | 50 years. |
| 16 | \$8 per cord..... | \$7 per cord..... | \$6 to \$8 per cord..... | |
| 17 | \$7 per cord..... | \$7.50 per cord..... | \$4 to \$7 per cord..... | |

(27.) VIRGINIA.

| | | | | |
|----|----------------------|----------------------------|-----------------------------|------------------|
| 1 | \$5 per cord..... | \$5 per cord..... | \$1 to \$1.50 (on trees) .. | 50 to 100 years. |
| 2 | \$4.20 per cord..... | \$4 per cord..... | \$4 to \$4.20 per cord.... | 5 years. |
| 3 | \$3 per cord..... | \$3.75 per cord..... | \$3 to \$3.75 per cord.... | 20 years. |
| 4 | \$5 per cord..... | \$6 per cord..... | | 28 to 30 years. |
| 5 | \$5 per cord..... | \$6.25 per cord..... | \$4 to \$6.25 per cord..... | 25 years. |
| 6 | \$5 per cord..... | \$5 per cord..... | \$5 to \$6 per cord..... | 20 years. |
| 7 | \$4 per cord..... | \$4 per cord..... | \$4 per cord..... | Always. |
| 8 | \$3.50 per cord..... | \$4 per cord..... | | 15 years. |
| 9 | \$5 per cord..... | \$5 per cord..... | \$4 to \$5 per cord..... | Few years. |
| 10 | \$4.50 per cord..... | \$5.25 per cord..... | \$3.50 to \$5.25 per cord.. | 25 years. |
| 11 | \$6 per cord..... | \$6 per cord..... | \$6 per cord..... | 100 years. |
| 12 | \$3 per cord..... | \$3 per cord..... | \$3 per cord..... | 50 years. |
| 13 | \$8 per cord..... | \$8.50 per cord..... | | 40 to 50 years. |
| 14 | \$4 per cord..... | \$4 per cord..... | | |
| 15 | \$3.50 per cord..... | \$3.50 per cord..... | \$3.50 per cord..... | |
| 16 | \$4.50 per ton..... | \$4.75 per ton..... | \$4.50 to \$6 per ton..... | 100 years. |
| 17 | \$3 per cord..... | \$3 per cord..... | \$2 to \$3 per cord..... | 10 to 15 years. |
| 18 | \$5 per cord..... | \$5 per cord..... | \$5 to \$6.50 per cord..... | 30 years. |
| 19 | \$4.50 per cord..... | \$3.50 per cord..... | \$4 to \$5.50 per cord..... | 20 years. |
| 20 | | | | |
| 21 | \$6 per cord..... | \$6 per cord..... | \$6 to \$10 per cord..... | |
| 22 | \$5 per cord..... | do..... | \$5 to \$6 per cord..... | 10 years. |
| 23 | \$6 per cord..... | \$6.50 to \$7 per cord.... | \$5 to \$7 per cord..... | |

²Specified as 1,650 pounds.

WEST VIRGINIA.

| | | | | |
|---|-----------------------|-----------------------|----------------------------|-----------|
| 1 | \$4 per cord..... | \$4 per cord..... | \$4 to \$4.50 per cord ... | 25 years. |
| 2 | \$10.50 per cord..... | \$10.75 per cord..... | \$9 to \$10.50 per cord... | |
| 3 | \$6 per cord..... | \$7 per cord..... | \$6 to \$9 per cord..... | |
| 4 | \$5 per cord..... | \$5 per cord..... | \$3 to \$5 per cord..... | |

(Table continued.)

(23.) WEST VIRGINIA.

| Number. | Counties. | Kinds of bark used. | Quantities used. | | Yield of bark per acre. |
|---------|-----------------|-----------------------------------|--------------------------------|-------------------|--------------------------|
| | | | 1880. | 1881 (estimated). | |
| 5 | Fayette..... | Chestnut, black oak, and hemlock. | Very little ¹ | | 1 to 4 cords.... |
| 6 | Hancock..... | Chestnut and black oak... | 32 cords..... | 38 to 40 cords.. | 2 to 10 cords.. |
| 7 | do..... | Chestnut oak..... | 100 cords..... | 115 cords..... | |
| 8 | Jackson..... | do..... | 75 cords..... | 80 cords..... | |
| 9 | Kanawha..... | do..... | 250 cords ¹ | | |
| 10 | do..... | do..... | 65 cords ² | 65 cords..... | 1 cord..... |
| 11 | Marion..... | do..... | 2,034 cords..... | 2,000 cords..... | 5 to 10 cords.. |
| 12 | Mason..... | do..... | 90 cords..... | 100 cords..... | |
| 13 | Pocahontas..... | Chestnut oak and spruce pine. | 12 cords..... | 12 cords..... | $\frac{1}{16}$ cord..... |
| 14 | Preston..... | Chestnut oak..... | 25 cords..... | 30 cords..... | |
| 15 | do..... | Chestnut oak and hemlock | 50 to 100 cords.. | 50 to 100 cords.. | 5 to 20 cords.. |
| 16 | Randolph..... | Chestnut oak..... | 25 tons..... | 20 tons..... | |
| 17 | Lincoln..... | do..... | | 50 cords..... | 5 cords..... |
| 18 | Taylor..... | do..... | 40 cords..... | 30 cords..... | 25 cords..... |
| 19 | do..... | Chestnut and black oak... | | 50 cords..... | 20 cords..... |
| 20 | Upshur..... | Chestnut oak..... | 50 cords..... | | 5 cords..... |
| 21 | Wirt..... | do..... | 400 cords..... | 400 cords..... | 3 cords..... |

¹Specified as 2,200.²Specified as 60 feet.

(23.) WISCONSIN.

| | | | | | |
|----|----------------|--------------|------------------------------|--------------------|------------------|
| 1 | Brown..... | Hemlock..... | 800 cords..... | 1,200 cords..... | |
| 2 | Dodge..... | do..... | 75 cords..... | 100 cords..... | None here.... |
| 3 | Kenosha..... | do..... | 4,000 cords..... | 4,500 cords..... | |
| 4 | La Crosse..... | do..... | 1,400-1,500 cords. | 1,400-1,500 cords. | 3 to 5 cords.. |
| 5 | Manitowoc..... | do..... | 350 cords ¹ | 350 cords..... | |
| 6 | do..... | do..... | 250 cords..... | 275 cords..... | |
| 7 | do..... | do..... | 3,750 cords..... | 3,500 cords..... | 8 to 10 cords.. |
| 8 | Milwaukee..... | do..... | 700 cords..... | 1,200 cords..... | |
| 9 | do..... | do..... | 3,000 cords..... | 4,500 cords..... | 10 to 25 cords.. |
| 10 | do..... | do..... | 80 to 100 cords.. | 80 to 100 cords.. | |
| 11 | do..... | do..... | 10,000 cords..... | 10,000 cords..... | None here.... |
| 12 | do..... | do..... | 3,500 cords..... | 3,500 cords..... | |
| 13 | do..... | do..... | 325 cords..... | 350 cords..... | |
| 14 | do..... | do..... | 1,200 cords..... | 1,200 cords..... | |
| 15 | Ozaukee..... | do..... | 350 cords..... | 700 cords..... | None here.... |
| 16 | Outagamie..... | do..... | 1,000 cords..... | 1,000 cords..... | do..... |
| 17 | Racine..... | do..... | 250 cords..... | 650 cords..... | do..... |
| 18 | do..... | do..... | 150 cords..... | 150 cords..... | do..... |
| 19 | Sheboygan..... | do..... | 1,000 cords..... | 1,000 cords..... | do..... |
| 20 | do..... | do..... | 830 cords..... | 1,000 cords..... | |
| 21 | do..... | do..... | 200 cords ¹ | 250 cords..... | |
| 22 | Winnebago..... | do..... | 600 cords..... | 500 cords..... | None here.... |

¹Specified as 2,200 pounds.

returns by States.

(Table continued.)

(28.) WEST VIRGINIA.

| Number. | Price of bark. | | | Estimated duration of bark supply. |
|---------|---------------------------|---------------------------|-------------------------------|---|
| | 1880. | 1881. | Range of prices since 1870. | |
| 5 | ----- | \$5 per cord.----- | ----- | 200 years. |
| 6 | \$8 per cord | \$7 per cord | \$7 to \$11 per cord | Few years. 20 years. 15 to 25 years. |
| 7 | \$8 per cord | \$7 per cord | \$6 to \$9 per cord | |
| 8 | \$6 per cord | \$7 per cord | \$5 to \$7 per cord | |
| 9 | \$7 to \$9 per cord | \$7 to \$9 per cord | ----- | |
| 10 | \$8 per cord | \$10 per cord | ----- | |
| 11 | \$5.50 per cord | \$6.50 per cord | \$5 to \$7.50 per cord | 25 years. |
| 12 | \$8 per cord | \$10 per cord | \$6.50 to \$10 per cord | Many years. |
| 13 | \$4 per cord | \$4 per cord | \$4 to \$5 per cord | 100 years. |
| 14 | \$4 per cord | \$4 per cord | \$3 to \$5 per cord | 10 to 15 years. |
| 15 | \$4 to \$6 per cord | \$4 to \$6 per cord | \$4 to \$6 per cord | |
| 16 | \$12 per ton | \$10 per ton | ----- | 10 years. |
| 17 | \$5 per cord | \$5 per cord | \$4 to \$5 per cord | 100 years. 40 to 50 years. 50 years. 10 to 15 years. |
| 18 | \$6 per cord | \$6 per cord | \$6 per cord | |
| 19 | \$6 per cord | \$6 per cord | \$6 per cord | |
| 20 | \$4 per cord | ----- | \$4 to \$4.50 per cord | |
| 21 | \$6 per cord | \$6 per cord | \$5 to \$6 per cord | |

(29.) WISCONSIN.

| | | | | |
|----|------------------------------|---------------------------------|---------------------------------|---|
| 1 | \$6.25 per cord | \$7.25 per cord | \$4 to \$7.25 per cord | 15 years. |
| 2 | \$10 per cord | \$10 per cord | \$10 to \$15 per cord | 20 years. Few years. All gone. Nearly exhausted. 15 years. 20 years. |
| 3 | \$9 per cord | \$9.50 per cord | \$6 to \$9.50 per cord | |
| 4 | \$6.75 per cord | \$7.75 per cord | \$5.50 to \$7.75 per cord | |
| 5 | \$7.50 per cord | \$8.50 to \$9 per cord | ----- | |
| 6 | \$7.25 per cord | \$7.50 to \$8.50 per cord | \$5 to \$8 per cord | |
| 7 | \$7.75 per cord | \$8.50 per cord | \$4.50 to \$8.50 per cord | 25 to 30 years. |
| 8 | \$8 per cord | \$9 per cord | \$5.50 to \$9 per cord | |
| 9 | \$8 per cord | \$9 per cord | \$8 to \$11 per cord | |
| 10 | \$8 per cord | \$9 per cord | \$5 to \$12 per cord | |
| 11 | \$8 to \$8.50 per cord | \$9 to \$9.50 per cord | \$5 to \$9.50 per cord | |
| 12 | \$8 per cord | \$9 to \$9.50 per cord | \$5 to \$9.50 per cord | 50 years. |
| 13 | \$8 per cord | \$9 per cord | ----- | |
| 14 | \$8 per cord | \$9 per cord | ----- | |
| 15 | \$8 per cord | \$9 per cord | \$5 to \$9 per cord | |
| 16 | \$7 per cord | \$7.50 per cord | \$6 to \$7.75 per cord | |
| 17 | \$8.75 per cord | \$9.25 per cord | \$8 to \$9.25 per cord | 25 years. |
| 18 | \$8 per cord | \$9 per cord | ----- | |
| 19 | \$8 per cord | \$9 per cord | \$6 to \$9 per cord | |
| 20 | \$8 per cord | \$9 per cord | \$6 to \$9 per cord | |
| 21 | \$8.50 per cord | \$9 per cord | \$4 to \$5 per cord | |
| 22 | \$7.50 per cord | \$8.50 per cord | \$7.50 to \$9 per cord | |

(c.) GENERAL SUMMARY OF PRECEDING TABLES.

(1.) Quantities of Bark used in 1880, and estimated Quantity in 1881.

| States. | Bark used in 1880. | | Estimated use in 1881. | |
|----------------------|-------------------------------|-------------|--------------------------------|-------------|
| | Number of tanneries reported. | Cords used. | Number of tanneries reporting. | Cords used. |
| Alabama | 20 | 1,000 | 17 | 927 |
| Arkansas | 3 | 115 | 3 | 690 |
| California | 10 | 3,832 | 11 | 4,765 |
| Connecticut | 4 | 1,515 | 4 | 1,570 |
| Georgia | 16 | 1,874 | 14 | 2,076 |
| Idaho (Ter.) | 1 | 30 | 1 | 50 |
| Illinois | 4 | 2,990 | 3 | 2,890 |
| Indiana | 22 | 6,770 | 20 | 6,784 |
| Kentucky | 9 | 1,645 | 10 | 2,210 |
| Maine | 29 | 63,544 | 30 | 77,107 |
| Maryland | 7 | 4,920 | 6 | 5,245 |
| Massachusetts | 25 | 34,237 | 26 | 34,904 |
| Michigan | 16 | 10,500 | 14 | 10,575 |
| Mississippi | 7 | 993 | 5 | 1,000 |
| Missouri | 7 | 2,231 | 6 | 2,452 |
| New Hampshire | 13 | 7,835 | 12 | 7,500 |
| New Jersey | 11 | 5,191 | 11 | 5,981 |
| New York | 133 | 263,744 | 129 | 281,830 |
| North Carolina | 24 | 2,648 | 22 | 2,526 |
| Ohio | 82 | 18,867 | 78 | 19,722 |
| Oregon | 5 | 970 | 3 | 470 |
| Pennsylvania | 207 | 300,122 | 115 | 310,686 |
| South Carolina | 7 | 605 | 6 | 615 |
| Tennessee | 26 | 24,135 | 26 | 30,789 |
| Texas | 5 | 397 | 5 | 495 |
| Utah | 3 | 118 | 3 | 118 |
| Vermont | 16 | 3,915 | 16 | 3,872 |
| Virginia | 23 | 11,881 | 20 | 7,946 |
| West Virginia | 18 | 3,493 | 18 | 3,233 |
| Wisconsin | 22 | 33,820 | | |

Yield of Bark per Acre.

| States. | Number reporting yield of bark. | Average yield (in cords). | States. | Number reporting yield of bark. | Average yield (in cords). |
|---------------------|---------------------------------|---------------------------|----------------------|---------------------------------|---------------------------|
| Alabama | 15 | 8.6 | New Jersey | 5 | 6.9 |
| Arkansas | 3 | 9.3 | New York | 76 | 12.1 |
| California | 4 | 37.5 | North Carolina | 16 | 8.8 |
| Connecticut | 3 | 10.8 | Ohio | 33 | 28.5 |
| Georgia | 10 | 5.7 | Oregon | 3 | 466.6 |
| Indiana | 9 | 14.1 | Pennsylvania | 112 | 14.8 |
| Kentucky | 9 | 9. | South Carolina | 6 | 3.8 |
| Maine | 16 | 3.7 | Tennessee | 14 | 6.2 |
| Maryland | 7 | 9.4 | Texas | 3 | 7. |
| Massachusetts | 5 | 9.7 | Vermont | 7 | 26. |
| Michigan | 6 | 17.8 | Virginia | 13 | 12.5 |
| Mississippi | 3 | 5.2 | West Virginia | 14 | 7.8 |
| Missouri | 1 | 4. | Wisconsin | 3 | 10.2 |
| New Hampshire | 3 | 7. | | | |

Prices paid for Bark in 1880.

| States. | Number reporting price of bark. | Average price paid per cord. | States. | Number reporting price of bark. | Average price paid per cord. |
|--------------------|---------------------------------|------------------------------|---------------------|---------------------------------|------------------------------|
| Alabama..... | 23 | \$4 38 | New Jersey..... | 15 | \$9 20 |
| Arkansas..... | 3 | 3 50 | New York..... | 152 | 5 06 |
| California..... | 10 | 16 87 | North Carolina..... | 24 | 3 38 |
| Connecticut..... | 4 | 7 63 | Ohio..... | 87 | 6 96 |
| Georgia..... | 17 | 4 70 | Oregon..... | 11 | 6 68 |
| Illinois..... | 4 | 8 81 | Pennsylvania..... | 334 | 4 54 |
| Indiana..... | 22 | 8 24 | South Carolina..... | 7 | 4 50 |
| Kentucky..... | 10 | 6 58 | Tennessee..... | 29 | 4 73 |
| Maine..... | 27 | 5 74 | Texas..... | 5 | 4 30 |
| Maryland..... | 10 | 7 48 | Utah..... | 2 | 11 50 |
| Massachusetts..... | 22 | 9 10 | Vermont..... | 15 | 6 27 |
| Michigan..... | 16 | 5 72 | Virginia..... | 22 | 4 68 |
| Mississippi..... | 7 | 4 57 | West Virginia..... | 20 | 6 45 |
| Missouri..... | 5 | 9 90 | Wisconsin..... | 20 | 8 23 |
| New Hampshire..... | 14 | 7 82 | | | |

Price paid for Bark in 1881.

| States. | Number reporting price of bark. | Average price paid per cord. | States. | Number reporting price of bark. | Average price paid per cord. |
|--------------------|---------------------------------|------------------------------|---------------------|---------------------------------|------------------------------|
| Alabama..... | 22 | \$4 54 | New Hampshire..... | 12 | \$7 46 |
| Arkansas..... | 4 | 5 50 | New Jersey..... | 12 | 9 31 |
| California..... | 11 | 17 98 | New York..... | 135 | 4 87 |
| Connecticut..... | 4 | 7 50 | North Carolina..... | 24 | 3 47 |
| Georgia..... | 16 | 4 78 | Ohio..... | 83 | 7 55 |
| Illinois..... | 4 | 10 05 | Oregon..... | 3 | 5 58 |
| Indiana..... | 23 | 7 86 | Pennsylvania..... | 224 | 6 77 |
| Kentucky..... | 10 | 6 90 | South Carolina..... | 6 | 4 25 |
| Maine..... | 27 | 6 15 | Tennessee..... | 30 | 4 80 |
| Maryland..... | 7 | 8 73 | Texas..... | 6 | 5 58 |
| Massachusetts..... | 24 | 10 31 | Utah..... | 2 | 11 50 |
| Michigan..... | 15 | 5 29 | Vermont..... | 17 | 6 56 |
| Mississippi..... | 5 | 4 70 | Virginia..... | 22 | 5 01 |
| Missouri..... | 5 | 10 95 | West Virginia..... | 20 | 6 19 |
| | | | Wisconsin..... | 21 | 8 82 |

(d.) NOTES TO THE PRECEDING TABLES.

ALABAMA.

1. We get most of our bark from the northern parts of Alabama and Georgia. The oak woods in this section are a thing of the past. The only tanning material that can be economized in this region is the sumac. It is very strong in tanning properties here, and there is much land in this region, allowed to run idle on account of its poverty, which, with a little care and small expense, would grow it successfully, if some person would put up mills for grinding it, and we have no doubt but that it would pay, besides affording employment to much labor in this section, as the picking time would come at about the interval that follows after the crops are laid by.

2. From neglect of seeding with valuable kinds of forest trees, such as oak and hickory, the lands that become worn out from tillage, they grow up in "old-field pines," the seeds being drifted by the winds from large trees in the neighborhood. The sumac is not gathered for tanning in this region. No experiments have been made with other barks besides the oak, and to a little extent the sweet gum. The latter will tan, but not so rapidly as the oak. In light goat-skins, the process was found to be about two weeks behind the oak. Green pine leaves have also been tried, and found to give a pretty color, but they are *exceedingly slow*. About half the timber cut for bark is wasted.

4. Tanning was formerly more practiced than at present, and those that have not quit the business will do so. No sumac is gathered, and no economies have been observed in respect to the use of barks, or the growth of timber. The timber cut for bark has generally been wasted. The trees were from 15 to 20 inches in diameter.

5. The trunks of trees cut for the bark are usually made into rails for fencing.

6. The wood from trees cut for bark is usually burned into charcoal.

7. All or nearly all the wood is used.

8. Companies from Chattanooga, Tenn., have cut more trees for bark this spring (1881) than had been cut before in all time. No use is being made of the timber, which is all chestnut oak, and in five—yes in *two*—years the supply will, at this rate, be exhausted. This cutting has been mostly done on railroad lands. About 10 trees make a cord of bark in this vicinity.

9. The timber usually left to rot.

10. As a rule, the timber is left to rot.

11. Timber mostly used as cord wood. Where 300 cords are cut, 15 are left to decay.

12. There is a large amount of chestnut oak, red oak, and black oak in the mountains of this part of the State (Jackson County). The timber of the chestnut oak is considered worthless; the other oaks are used for farm purposes. Sumac is abundant in the county, but is not used for any purpose.

13. The timber of trees cut for bark is left to decay. Tanning is done in Jackson County on but a small scale. The oaks furnishing bark grow chiefly on the mountains, the timber in the valleys being of different kinds. The black and chestnut oaks chiefly used. Some use white oak, of which there is a plenty here.

14. No attention is paid to timber after it is peeled. Thousands of cords have been gathered on the mountains in Jefferson County, and shipped to Louisville, Nashville, Saint Louis, and some has been ground and shipped to England. It is difficult to get out, as the mountains are steep and rocky.

15. The timber is usually left to rot. It would yield at the rate of about six cords of wood to one of bark.

16. In the northern part of Pickens County there is some bark left, but it is nearly exhausted in the southern part, or in such small quantities that it cannot be relied upon. The timber is generally used; in former years it was wantonly destroyed. I have noticed that the quick rank growth of pine that is growing nearly all over the South is killing out the red and black oak. The white oak appears to be more hardy, and to thrive and bear fruit. I am convinced that the sumac growing wild all over the South could be cultivated and be made a paying crop. It thrives finely, even among other bushes, wherever it is under fence, and the stock kept from breaking it down in the growing season. I would also especially recommend the growing of the common china tree for its berries for feeding sheep.

18. About half of the trees cut for peeling are left to decay.

19. But very little timber is used; the most of it is left to decay. The oak timber in this part of the country (Shelby County) is rapidly dying out from some cause, and my opinion is that tan-bark in this vicinity in ten years from this time will be very scarce and dear. It appears to be rapidly going like the chestnut. There is not a single chestnut tree left alive in my vicinity, where 20 years ago they were plentiful. What the tanners will do in a few years for supplies is a most serious question.

20. All of the timber cut for bark is left to decay, and the supply of bark in this vicinity is pretty well worked up. Sumac is abundant, but it has not been used. The principal timber of this region is the long-leaved pine, which is fast disappearing along the lines of railway.

21. About 2,000 cords of wood left annually to rot. The price of bark has been uniform for the last ten years.

22. The wood usually left on the ground; sumac grows plentifully, but is not used for tanning. Timber is cut in this county (Tuscaloosa) with very little regard to economy, either of bark or timber, and those who peel generally waste a quarter by neglecting to take it clean from the trees. The most valuable timber in this section is the yellow pine, which is being sawn up very rapidly of late.

23. The timber is generally not saved, but no estimates of the waste could be given; sumac grows abundantly, but is not used.

ARKANSAS.

The few returns from this State afford but little information; sumac is reported as plenty, but not used, and the timber cut for peeling is generally left to decay.

CALIFORNIA.

1. The oak used for tanning grows among the red-wood timber of the Coast Range, and the yield is from none up to 100 cords per acre. The trees yield from a quarter of a cord to two cords each. About half of the bark used by this establishment is peeled within five miles of the Coast Range Railroad, and the wood is saved, the other half, perhaps 1,500 cords decays. Suggestions have been made for planting the black wattle (*Acacia*) from Australia, but this has not yet been done. Some attempts were made at grinding sumac, in Los Angells and San Diego Counties, but without success.

The belt of timber furnishing our tan-bark in California, extends from the Bay of Monterey in the south, to Humboldt County in the north, with an average width of 10 to 15 miles. All that is accessible is brought to market first, and in Santa Cruz and Sonoma Counties more than half of the supply is used up. The consumption is on the increase, and in a few years there will be little left south of Mendocino and Humboldt Counties. In the future, higher prices will probably rule, and the old places will be searched, and roads built to places now inaccessible, whereby the supply may be made to last twenty-five years yet. So far, no substitute has been found, the black oak and live oak being unserviceable for tanning. Our bark is strong, one cord tanning 12 hides, or 400 pounds of sole leather, on an average, the hides weighing 60 pounds each when salted.

2. All the trees cut for bark are used as fuel at the mines. The leather made is chiefly sheep-skin—100,000 in russet or back linings, and 200,000 in glove and shoe stock, by chemicals in which no bark is used. In answering inquiries concerning supplies, we refer to the supplies on Saint Helena Mountain, Napa County, California. About one square mile is pretty well covered with trees. In the surrounding country, the trees are so scattered that at present rates it would hardly pay to peel them. There is a limited quantity high up among the surrounding hills, probably enough to justify a statement of three years' additional supply. We do not include any coast country in our estimate. With regard to sumac, it is thought that the land is here well adapted to its growth, and its cultivation should be encouraged.

3. The oak furnishing bark may average four cords to the acre. In some instances it will cut 20 cords and in some none at all. It is rather scattered in this vicinity. Much of the wood is left on the ground. The tan-bark on this coast is limited to a belt of land along the coast, reaching from Los Angeles to the Oregon line, and at the present rate of consumption it will not last in this State thirty years. This county (Humboldt), the most remote from the center of tanning, is now shipping bark to San Francisco, and, if continued, it will not take many years to remove all the available bark from the county.

4. The wood of trees cut for the bark is mostly used for fuel and lumber.

5. Most of the wood is sent to market. Every encouragement should be given to the propagation and preservation of our native forests. It is conceded that the quantity of tannin contained in our oak could not be equaled in the world. A great deal of bark is cut on government lands and the wood left to rot. The wood is worth but \$2.50 to \$3 per cord, while the bark sells at from \$14 to \$18 per cord.

6. The wood is partly left to decay, the rest is used for firewood.

7. The wood is usually left to decay. It is only within the last two years that they have begun to save what is near a railroad. The chestnut oak here used for tanning is of very superior quality, and there should be a law requiring it to be replaced by planting.

8. Wood is usually saved for fuel. The supply of bark easy of access is being rapidly consumed. There are some quite large tracts that in time might be reached, but are at present not accessible, either in location of tannery, or in shipment of the bark itself, with any economy whatever. There are many who think that the tanning business here cannot be enlarged to any great extent without enhancing the price of bark beyond what tanners can afford to pay.

9. In former years, about three times as much bark was used as at present, it hav-

ing been replaced by gambier or tanning extract imported from China and India. The extract of hemlock bark is used in connection with our tan-bark.

10. The supply of oak bark will probably continue for a hundred years to come; still precautions should be taken against the total destruction of our forests, as their annihilation is merely a question of time.

11. A portion of the trees are cut into firewood. The Australian wattles will do well in this State, and some of them are growing here now, as ornamental trees. None, however, have as yet been planted for the purpose of supplying bark.

CONNECTICUT.

All the tanneries reporting state that the wood of the trees cut for peeling is used. Some little sumac has been used in tanning in a few instances.

GEORGIA.

1. Trees mostly left to decay on the ground. It is thought that the extract of oak bark could be manufactured for exportation in this region, as the local supply of bark is large.

2. Black oak yields about five cords to the acre; chestnut oak, three. The trees are mostly left on the ground.

3. Most of the wood is used for fencing and fuel. Sumac grows plentifully, but is not used. An old tanner here uses pine boughs, and is said to have good success. His method is not stated.

4. Part of the timber is used for fencing, the remainder is left. Much of the forest has been destroyed for bark, in the region comprised in Cherokee County, Alabama, and in Floyd County, Georgia, the wood being suffered to rot. In future we think much of it will be used by sawing into bridge timber, ties, &c., for the railroads, and for fencing, &c.

5. Wood generally used for fuel and fencing; sumac grows abundantly, but is not used.

8. This region having been settled many years, much of the original timber has been cut away. It was chiefly oak and hickory, and its place is being supplied by old-field pine. Tanning material has become scarce, and all the tanneries are closed, but one, which must soon stop business for want of bark, unless the extract is used. The owners of the remaining bark will not allow it to be cut.

9. The timber is commonly left to decay on the ground. The supply of bark is limited, and might easily be exhausted.

10. The quantity of oak is thought to be large. The trees cut for bark are generally used. No sumac is gathered.

12. There are a few localities in Middle Georgia where bark can be supplied in quantities to do a small tanning business for a few years. It is more abundant among the mountains, in the northern part of the State. The greater part of what remains of the woodlands of Middle Georgia is mostly reserved for firewood and timber for local use, and not much land in original growth remains to be cleared up.

13. Bark is thought to be abundant. No sumac is gathered for use.

14. The timber is mostly used up. No sumac is gathered. The bark is peeled only from the main trunk, never from the branches, and, if more than six miles off, the wood is left. The supply of oak bark is deemed ample for present uses.

15. Bark is scarce, and when the oak is gone we see no chance for tanning here.

16. Bark is becoming scarce, but enough to keep a small business in operation for some years.

17. The supply of bark is large, and there is much more destroyed every year than is used. Although the most valuable native product of the land, the farmers cannot be made to believe it. One reason that leads to this neglect is, that the bark must be peeled at the season when the farmer is most busy with his cotton crop. Bark will not bear transportation more than eight miles to a tannery, in this region.

IDAHO.

But one return was received from this Territory. It came from Bear Lake County, and reported the use of 50 cords of bark, from mountain timber, so scattered that no estimate of the rate of yield could be given. The timber was all used up.

IOWA.

Returns were received from three small tanneries, chiefly using the white and black oak barks. One of these used about a ton of native sumac a year, for sheep skins, and for this use it was preferred to bark. Another mentions the sumac as of good quality, and in great abundance, but not in use. As the peeling of bark can only be done in the busy season with farmers, they could not be induced to cut their wood at a time when the bark could be saved. A third report mentions the bark as procured elsewhere, as what is grown is too poor for use. The forests were fast disappearing, and there was no planting for a future supply.

ILLINOIS.

1. The bark used in this establishment comes from Michigan.
2. The bark is brought from over 400 miles away.
- 3, 4. No bark grown for tanning.

INDIANA.

1. The wood of trees cut for bark is used for spoke timber. Some 10 per cent. of supply is from second-growth chestnut oak ten to fifteen years old, from land that has been once cleared.

2. About one-quarter of the timber is saved, the rest wasted.

3. The timber from trees that have been peeled is usually employed for ties, or is cut into staves. The supply may last perhaps twenty years. Sumac is gathered and sold in the leaf to New Albany, Ind., and to Louisville, Ky., in large quantities.

4. The oak timber is very thin here, and we think in ten years there will hardly be any oak within from six to ten miles. The timber is used for staves and fence rails.

5. About half of the timber is used for fire-wood. Sumac is gathered for tanning, but the quantity is not stated.

7. Trees yield about half a cord each; the yield per acre is very uneven, sometimes but two and at other times ten cords. The timber is generally used for spokes, staves, rails, &c. There is much bark wasted, because the trees are cut when the bark will not peel.

8. In the adjoining county of Bartholomew, probably 2,000 cords a year of bark are cut for tanning.

12. Wood is considered of little value in this region. Chestnut-oak bark we consider the best for all purposes, and our supply comes from Brown and Monroe Counties, but it is becoming very scarce even there. It grows there on the hill-sides, upon land that is not considered tillable, along with sassafras and hickory. If protected from forest fires, it would in a few years cover the hills, and be of value. The small branches might be used to advantage if properly cured. The chestnut oak should be *fostered*, if we are to retain our national reputation as leather manufacturers.

13. It has been the remark for the last fifteen or twenty years that the bark was almost gone; but people here are becoming more careful of their oak timber, and there appears to be a plenty at present prices for the next ten years.

14. Most of the hemlock bark used comes from Michigan, and the chestnut oak from Ohio. There is no bark for tanning here but the white oak, and that is not strong enough. The tanners have quit using it, except for light stock.

15. Bark is used up in this part of the country, and we will have to look elsewhere, if we continue business. The farmers have their land about cleared up, and the supply is almost exhausted. Business is closing up, owing to the scarcity of bark.

16. The timber is mostly allowed to decay.

17. The wood mostly rots. Sumac has been gathered for about twenty years for the Evansville market, but it is now nearly exhausted.

18. The trees cut are small, and the timber is not saved.

20. The bark used comes from Kentucky and Tennessee.

21. The wood is all used for staves and lumber. The oak is nearly all used up, where the bark can be saved.

22. The Wabash Valley is tolerably well timbered for a distance of three to five miles on each side of the river, beyond which it is prairie.

23. Two-thirds of the timber is wasted. In some places where cuttings have been made, young trees spring up, but they are often destroyed by fire. When so injured, they are sometimes cut for bark when half grown. The supply here will be almost exhausted in fifteen years.

24. The oak is disappearing rapidly, and we are using hemlock that is brought on the cars. It is thought more profitable, and costs but a little more than half as much as oak.

25. This is the only tannery in Wells County, and the limited supply of bark occasions difficulty. The timber is usually cut in the winter, when it will not peel, and much is thereby lost.

KENTUCKY.

2. Most of the timber cut for peeling in this region is left to rot on the ground.

3. Less bark could not be used than at present. Timber may be cultivated as in Europe. No substitutes have been found for bark that answer every purpose. Sumac grows, but is of little value, and it is not of late prepared for tanning.

4. In reference to the duration of supplies of bark, twenty-five years ago this supply was thought to be nearly exhausted. But by going further back among the hills, and on the roughest ground, it is still obtained, but the supply is nearly exhausted. It now takes two days to get a load to market.

5. A large part of the timber is left to decay. Sumac grows plentifully, but none is gathered or used. We are in the midst of a bark region, and thousands of cords of

chestnut-oak bark are peeled and sent to Louisville and Cincinnati markets, at from \$10 to to \$12 per cord, delivered on the cars. At the present rate, it will not take five years to exhaust all of the bark of Southern Kentucky. As for sumac no attention is paid to it, although it is plentiful all through Southern Kentucky.

6. Most of the timber has been left to decay, although they are beginning to manufacture it into staves. Sumac grows and is believed to be of good quality, but we think has not been collected. Large quantities of timber, staves, &c., are being shipped from this region.

7. Only the best trees are saved; probably 2,000 cut for supply of this establishment are left to decay.

8. There is a growing disposition to use extracts. Sumac is common, but not used. Black-oak bark is plenty and cheap.

9. Timber mostly left to decay. At the present rate of use the growth of young timber is sufficient to supply the place of that which is cut.

10. About 1,500 trees a year are cut and left to decay. Bark is taken only from the body of the tree. We have a considerable amount of black oak that will tan, and also white oak, but neither of them contain much more than half the quantity of tanning material that is found in the chestnut oak. Fifteen miles east and south of Mount Sterling there is much of this timber, but it is not at present accessible. Much bark has been shipped to the cities from this region within the last six years.

11. The timber is left to decay.

LOUISIANA.

1. The timber cut is generally lost; a little only being saved for fencing, &c.

2. Now for the second season, all of the timber has been used for various purposes. Sumac grows plentifully, but has not been much used.

MAINE.

1. About half or two-thirds of the timber cut for peeling is saved.

2. This establishment does but a small business, but if reporting for others there might be noticed a large destruction of hemlock trees, beginning at Winn, Me., Penobscot County, and extending north and east. At the present rate of consumption the grand forests of Maine will in fifty years be nearly cleared of the hemlock trees now living.

3. The timber is all sawn into lumber.

4. Wood used up for fuel. Sumac is used to some extent for tanning purposes.

5. Bark mostly derived from Canada.

6. The timber is used.

8. The timber is always used.

9. The logs are used for lumber and wood. Sumac is gathered and sent to Salem, Mass., and other places.

10. The hemlock timber is all used for lumber. A belt of hemlock occurs in Washington County, with a prospect of use.

11. Wood used up. Sumac is gathered in a limited way. The bark in this vicinity is being used very fast, as no pains are taken to improve its growth. Small trees are cut that should be left to grow, as the bark is worth little, and the lumber less.

12. 13. The timber is used up.

14. Large quantities of hemlock bark are shipped from Canada to the Eastern States. It is sold in Boston at \$11 a cord.

15. This may be said to be the oldest tanning section of the State, and consequently the bark is well exhausted. In the more newly settled portions of the State much of the timber cut for peeling is not used, or has not been, but it is now being more generally used, since pine and spruce are growing more rare.

16. The lumber is generally used.

17. It is estimated that a million feet of lumber is left to rot in the woods annually. Since this establishment began operations, about 100,000 cords of hemlock bark have been used. About 250,000 cords are still available, sufficient for a supply of about twenty years.

18. The timber is generally used.

19. Probably half the timber is wasted.

20, 21. The timber is generally used.

22. The lumber is used. Sumac is abundant, and might be used.

23. The hemlock is much scattered among other trees, and is commonly used.

24. It is doubtful whether there is ever any more tanning done in this town, as the vicinity is nearly stripped of its bark. The timber is all used up for boards, &c.

25, 26. The timber is generally used.

27. The time that hemlock will last in this region will depend on the care taken to keep out the fires. Large quantities of extract are made in New Brunswick, and fully half of our bark comes from this province.

28, 29. The timber is used for mechanical purposes.

30. Bark from this region is sold to places out of town.

MARYLAND.

1. The bark used comes from various parts of Virginia. The best is from the chestnut oak and is believed to be in ample quantity.
2. Not more than a quarter of the timber is used; the rest is left to rot.
3. The wood is mostly used in burning lime, and for fire-wood.
5. Very little wood is left to decay in this region. Some sumac was sent to the Baltimore market five or six years ago, but none since, nor do we hear of any demand. Our bark is chiefly furnished by farmers, who in the course of their cutting save the bark. Sometimes a tract of woodland is bought by speculators and cut off for railroad ties and fire-wood, leaving the land to its owners in two or three years. In a few cases this land is allowed to grow up again. The timber is destroyed here twice as fast as it grows.
6. Our bark comes from Virginia, where the yield is from four to five cords to the acre, and the supply is abundant. The wood is commonly used for cross-ties and fuel.
8. Manufacture sumac for market, and this year (1881) will grind about 400 tons. It is generally sold in Philadelphia, Wilmington, and the New England States. I have been handling chestnut-oak bark for forty years, and have during this period seen it as low as \$3 a cord, and as high as 9. It is my opinion that in five years from now all the chestnut oak bark in this section will have been exhausted; in fact, this season the tanners throughout the country have not got a supply.

MASSACHUSETTS.

1. The timber is all used; none is left to decay. Tanning establishments must decrease in number.
2. Bark is nearly used up in this vicinity, and it costs too much to make the business pay. In other localities, where it costs no more to transport to market than from here, the bark can be bought for one-half of what we pay.
3. Our bark comes by rail from Canada.
5. Our bark is brought by railroad from Northern New York and the northern part of New England, and from Canada, or by water from the coast of Maine and the British provinces. [This remark applies to the Essex tanneries generally.]
8. The hemlock extract used will average about 450 pounds to the barrel, and 300 pounds are said to contain the tanning properties of a cord of bark.
14. In tanning with sumac, we find that Sicilian sumac will tan as much from one bag and a half as the American will in two. The former gives a white and the latter a yellow color. Sometimes we find some sand in the American bags, that has been put in to defraud in weight. The farmers take the sumac after it is spent to apply to their lands.
15. In Salem and Peabody (Essex County) the quantity of hemlock bark used for tanning is about 40,000 cords a year, of which nine-tenths come from the British Provinces and the remainder from New Hampshire and Maine. Two-thirds of the total amount is brought by railroad, the balance by sea. The prices have averaged \$10.50 per cord for the last five years.
22. The amount of bark used in this vicinity is every year increasing, and nearly all of it comes from Canada, a small portion from New Hampshire, and some from northern New York. The present outlook is, that the supply of bark will, before many years, be exhausted, and that some other material will have to be used for tanning.
24. About half the wood cut for supply (about 1,600 trees) is left to decay.

MICHIGAN.

1. Bark is very scarce, and is obtained from other places.
2. Of 17,500 trees used, more than half went to waste. It seems impossible to protect hemlock forests; they are exceptionally sensitive to exposure, either to light or forest fires. The hemlock, like the Indian, "must go." Chemistry must provide the tanning agent of the future, although oak may be cultivated to a considerable extent. The supply here is exhausted, and we shall abandon one tannery this season.
3. All timber is used up very close on account of scarcity. The tanning barks are all now used up in from 10 to 20 miles. No methods of preservation were employed with first settlement, and the timber was sold, except a little reserved for fire-wood. In England, an oak tree planted in the hedge row once in a hundred feet makes a pleasant shade for animals, and gives them much timber. It appears that a single generation will consume all the bark in this State, as well as others. In forty years we have seen extensive regions entirely denuded in some of the older States.
4. Most of our hemlock bark comes from the northern part of the State, 150 miles away. Most of the trees cut in this vicinity for bark are saved for fencing and fuel.
5. The sweet fern, growing on the Norway pine plains, is of some value for tanning, but, owing to small growth, it is not gathered. It is best adapted for calf-skins.
6. About a third of the timber peeled for tanning is saved; the rest is left to decay. It takes on an average about four or five trees to make a cord of bark.

8. Bark is shipped from about 200 miles away. Ten or fifteen years ago there was some oak in this vicinity, but it has all been cut, and none has been planted.

9. Most of the timber is left on the ground. The present supply may last ten years, if fires do not destroy it. I do not know how to prevent the destruction of hemlock timber. Where they cut out the pine the hemlock dies as soon as it is exposed to the sun.

10. The timber is all used. About 2,000 cords of bark a year are shipped from a point a few miles west of this to Chicago.

11. This county is mostly cleared up, and we have only patches of oak timber. The timber is saved.

16. There is no tanning material as cheap as hemlock bark at twice its present cost. About 20 tons of Sicilian sumac are used, and we find it much better than the American. For some kinds of stock the American stock does well, but where you want solid and light-colored leather, the Sicilian sumac is superior to the American.

MINNESOTA.

1. Our bark comes from Marathon County, Wisconsin. There is no hemlock in this part of Minnesota, and the oaks here contain no tanning properties worth using.

2. Bark is brought from Wisconsin.

MISSISSIPPI.

1. Bark trees are very scattering, as this is a pine region for 10 or 15 miles around. The timber when peeled is mostly used for fence rails.

4. The supply of oak in this vicinity is used up, but it can be obtained a few miles away. Sumac grows here, though none is gathered for market.

6. Trees not used after peeling.

MISSOURI.

1. The timber is used for rails and cordwood.

2. No bark is obtained in this county; it comes from Tennessee.

3. The sumac is abundant and of good quality in this vicinity, but not used. Timber affording tanning materials abounds in the hilly and rocky regions, and the wood is commonly used.

6. The bark mostly used here comes from the vicinity of Chattanooga, Tenn., and is from the chestnut oak. It is mostly found in Kentucky, Alabama, and Tennessee, and some comes from Ohio and Indiana.

7. Our chestnut oak comes from Tennessee and Alabama, and our hemlock from Michigan and Wisconsin.

NEW HAMPSHIRE.

1. The timber is sold at \$5 to \$5.50 per cord. Some sumac has been sent to Portland and vicinity.

2. The current price of bark has gradually risen from \$8 in 1870 to \$10 in 1881. This is partly due to the opening of railroads that enable bark to be carried to the great markets.

3. About 3,000 cords of hemlock bark are shipped annually to Salem, Mass., from this vicinity.

5. But little bark is to be had in this vicinity.

7. All the old growth has been cut off, and the bark we get now comes from small and scattering trees mixed in with other kinds of timber. One-third of the timber cut for bark is wasted. Although there is a considerable amount of small wood growing, yet there is but very little fit to cut for timber in this vicinity. Many small streams are nearly dry, and the larger ones have a perceptibly smaller flow of water than formerly.

12. It may be estimated that 200 cords of bark are taken in this town (Hancock) annually.

14. In this region there is a considerable quantity of sumac and sweet fern; both of them are valuable tanning agents, and could be easily cultivated.

15. The supply for 20 miles around is mostly exhausted, and bark is brought from 50 miles further north. By present methods there is a great waste, and all of the tanning material in the bark is not used. As prices increase, tanners will be forced to work closer, one-quarter of the value being now sometimes thrown away.

NEW JERSEY.

1. Most of the oak bark now gathered in this locality is taken from trees of second and third growth, the wood being used for fuel or charcoal. The supply is very limited and cannot be kept up many years longer, as much of the wood is cut in the winter season, when the bark cannot be saved.

2. In making patent leather for the carriage and shoe trade, we must get the stock soft and spongy, and this is attained by using gambier for about half of the tanning,

although it costs more than bark on the average. All of our bark now comes ground and in sacks, it being found cheaper in this form than in the leaf. It is chiefly from New York, Pennsylvania, Virginia, and the mountains of New Jersey.

3. We have been in business since 1824, and the prices have averaged about the same since that time, viz: \$14 per ton for ground oak and \$12 per ton for ground hemlock. In the earlier years the supply came from the immediate vicinity; it has gradually been cut away, and of course had to be brought from greater distances, but the era of cheap transportation has progressed in the same proportion, as the distance increased, so that prices have remained about the same.

4. Timber large enough for bark is scarce in this vicinity, as the woodlands have been cleared for farming. The counties south and southeast have more timber, but it is coming into market fast, and a great deal is being destroyed by fires. These causes make bark more scarce. We use some from Pennsylvania and some ground bark from Virginia.

6. Bark would be more plenty if wood was not cut in winter. The forest fires do great injuries, especially along railroads.

7. Hoop-poles have been cut in this region for nearly sixty years, destroying the valuable oaks and hickories, and leaving mostly the chestnut. The growth of wood will not keep up with the wants of the country, and the valuable timber is nearly exhausted.

10. There was a large number of small tanneries in this region some twenty-five to fifty years ago, each having its local trade. They are mostly gone, and Newark gets most of the bark from this part of the country, the canal and railroads affording convenient transportation. The scarcity of bark will soon close all the tanneries of this part of the country. Native sumac was formerly gathered for Trenton, Philadelphia, and other markets, but that from Virginia has superseded it.

11. Timber land in this part of the country has been nearly all cleared up. There are parties that go about paying \$50 to \$75 an acre for the timber without the land, wherever they can find it. The bark is sent to Newark and the timber worked into railroad ties and other uses. Some is sawn into plank, some rived into staves for nail-kegs or cut into fire-wood. The tanners of small capital have found themselves unable to compete with the large establishments, and have been forced to stop business or turn their attention to cheaper stock.

NEW YORK.

1-4. The timber cut for peeling is generally all used up.

5. About 25,000 trees are left to decay every year.

6. The timber is all used up. It is estimated that it yields about 1,000 feet of lumber to a cord of bark. The large tanneries will have to stop business in about four years. It would be advisable to encourage the planting of the larch, as in Scotland. It is a good timber, and its bark is used for tanning.

7. It is estimated that 1,200 feet of lumber is yielded to a ton of bark. Hemlock timber is of slow growth, and it is conceded by all tanners of this vicinity that this timber is dying and becoming worthless for tanning faster than it is gaining in growth.

8-11. The timber is all saved. (No. 11 reports 4,000,000 feet from bark-cuttings.)

12. Timber saved. The land when cut over is left waste and grows up with briars and wild cherry.

13. The timber is used. Hemlock is decreasing fast and there cannot be more than 6,000 or 8,000 cords left in this vicinity.

14. Timber all used. A considerable amount of bark is shipped from here to point east and west, from 500 to 1,000 cords a year.

15, 16. The timber is all manufactured and but a small per cent. lost.

17. It is estimated that 1,500 feet of lumber are made to a cord of bark. The tanners in this region have endeavored to protest against the cutting of hemlock in winter, because the bark is then entirely lost, and it will soon become scarce.

18-24. The timber is all saved.

25. Timber saved. All the desirable hemlock lands in this vicinity, and northern Pennsylvania, have been bought up recently by large sole-leather companies, and we think that in about five years all the larger tanneries that use over 1,000 tons per annum and have no bark lands will have to stop or remove to other locations. The sweeping off of hemlock timber is fearful to contemplate.

26-29. The timber is all cut into lumber.

30. The hemlock bark of this county (Clinton) will in a very few years be all exhausted, or nearly so, and no methods have ever been devised for reproducing this material.

31. Other parties have paid \$7 for bark in 1880, and have contracted large quantities on the trees at \$4 per cord, and peel it themselves. The hemlock bark is becoming less every year, and large quantities are destroyed by forest fires. The wood is used for lumber, fuel, and charcoal.

30-32. Timber all sawn into lumber.

33. The hemlock timber in this county (Clinton) is getting very scarce, and a few years will entirely exhaust the supply.

34. Timber all used.

35. Unless some substitute for bark is found, the tanning business in central and western New York must in a few years cease, or supplies of bark must be shipped from other regions.

36. Lumber in the log is worth \$1 to \$1.25 per thousand feet. It is suggested that the Government of the United States should take care of the tanning material. It is becoming a question of great practical importance.

37. The lumber is all used.

38. The supply of bark is derived from a large area of country, and will probably remain constant for some years.

39, 40. The timber is all manufactured for use.

41. The lumber is saved. The bark is peeled from a great deal of land where the hemlock is mixed with hard wood, say about half of each. In the spring, the fire will often get into the forests, and kill all the small hemlock trees and the hard wood, so that the whole tract is worthless. If some means could be employed to keep out these fires, the growth would produce a new crop.

42. Lumber used for building purposes. The supply of bark is becoming scarce, and it is found only in small parcels.

43-45. Lumber all used.

46. Trees saved for lumber and fire-wood. An extract from green wood, chiefly beech, is used successfully for tanning calf, kip, and harness leathers. It is suggested that the planting of oak upon land too hilly for agriculture be encouraged by exemption from taxation.

49. Hemlock timber is becoming scarce, and as there is no oak in this section, it is difficult to foresee what means will be used for continuing these supplies, unless some material is discovered that will take the place of barks for tanning purposes.

50, 51. The timber cut for peeling is used for lumber and fire-wood.

52. Believing that within twenty-five years all the hemlock forests of the United States will have been cleared away, with the exception perhaps of Maine, I have often suggested to land owners and to tanners, that the kinds of timber furnishing tan-bark should be cultivated, and that a beginning should be made now in good season. Oak would probably be the best for cultivation, and in this we should profit from the experience of Germany, and arrange for cuttings at intervals of twelve or fifteen years, *ad infinitum*. In this manner a most excellent bark is obtained, said to have double the strength of hemlock bark.

53. Supplies are derived from Canada. It is thought that all the timber of trees cut for bark is used.

55. If the exportation of bark extracts to foreign countries continues, our tanneries will in a few years be left without bark.

57. The bark used at this establishment comes mostly from western Pennsylvania, where from ten to twelve cords per acre is a fair yield, and in exceptional cases twenty cords. The supply of barks for tanning, and especially of hemlock, is rapidly drawing to an end. The soil where the hemlock grows (referring to the hillsides, in western Pennsylvania, where the soil is thin, and unfit for common agriculture) will not reproduce the same timber, excepting under peculiar circumstances. It would, therefore, be very much better to plant oak trees, which may be made to produce a crop at intervals of about twenty years. The trees are then 4 or 5 inches in diameter, and the bark is the very best for tanning purposes.

58. The timber is used. From 100 to 200 cords of bark are sent annually from this vicinity to Troy, Albany, &c.

59. Not much of the timber is used; from 15,000 to 20,000 trees are left on the ground.

60. Most of the timber is cut into lumber.

61. Lumber closely used up. If some substitute is not found soon, we shall have to stop manufacturing soon. The attention of the department should be particularly turned to the tanning material of the country. In this region it is about used up. It is earnestly hoped that some measures will be devised for the protection of this interest.

62-66. The timber mostly used.

67. There has formerly been great waste, but bark is at present generally cared for. There seems to be lack of judgment in curing bark. It should be peeled and turned smooth side up to the sun, and be put the same day into piles. This question of bark-supply has become of great interest to tanners, and we all realize that a few years at most, in this section, will leave us without the means of making leather, unless some substitute is made available.

68, 69. Lumber mostly saved.

70. No doubt there is more bark used than is necessary owing to imperfect leeching.

72. The timber is saved. The exportation of extracts to foreign countries is sadly against our interests; our bark will soon be used up, and nothing to show for it.
73. The bark we use is peeled from trees that have been damaged by fire, or that have been blown down. All of the timber is used, and there is no wholesale destruction as in times past.
74. The timber is used. No substitute for bark is known.
75. The timber is used; the trees average about three to a cord of bark. The supply may last in this place about seven years; in other places in this region, twenty.
76. About two-thirds of the timber peeled is left to decay.
78. If the wild lands from which the bark is cut were allowed to grow up again, the supply might be maintained.
79. From one to two millions feet of timber are wasted.
80. A portion, perhaps 2,000,000 feet of lumber, is wasted.
81. The report answers for two other tanneries in this (Lewis) county. The hemlock in the forests of Northern New York is being rapidly wasted, and from fifteen to twenty years will exhaust it. As bark becomes more scarce, and higher priced, more economy will be experienced in gathering it, as now in Europe.
82. Hemlock is chiefly used—a very little birch. It is very evident that some substitute must be had in the near future.
83. The timber is all used. The bark has been cut very freely for a number of years, and sole-leather tanneries have been obliged to seek new locations. Only light tanning is done here, and the bark for these will not last more than fifteen years.
84. The hemlock is very much cleared off; all the lumber is saved.
85. The hemlock timber is scattered, and the amount cannot be estimated.
- 85-87. The timber is saved.
88. The most of the hemlock is used up, from the Niagara river eastward, along the shore of Lake Ontario, for a distance of 80 to 100 miles. Our stock comes by railroad from counties further south. The tanners of this region are removing into timber sections.
89. The supply of bark is getting to be a serious question, and something should be done before the supply runs out. The lumber in this region is all saved.
90. The timber is saved, mostly for railroad ties, cordwood, and charcoal.
93. We estimate that the hemlock bark will be nearly all exhausted in Northern New York, in about ten years. The timber is all sawn into lumber, yielding about 1,000 feet to the cord of bark.
94. Of the bark used, about 1,000 tons came from Osecola, Lewis County. The timber from which it was taken will not be used.
95. Supplies of bark are gotten from farmers living within ten miles.
96. About half of the logs are left to decay on the ground.
97. Bark is becoming very scarce; the yield would not exceed a cord to a hundred acres. Supplies are brought by rail and boat, from 50 to 60 miles. The wood is all used.
98. Land is getting cleared up close in this section, and little wood is left to decay. As for hemlock bark, something must take its place in the near future.
99. Supplies mostly come from adjoining counties. There is not much hemlock here. Most of the wood is used.
100. This is an old settled town, and the hemlock is only cut by the farmers, as they want material for fences and building.
- 101, 102. The timber is all cut into lumber.
103. Supplies brought by railroad from 25 to 30 miles away. There is a great want of care in the curing of the bark. Would be worth \$1 or \$2 a cord more, if greater attention were given to this preparation.
- 104-106-108. The timber cut for bark is all saved.
109. The timber is cut into railroad ties, or fuel for brick yards.
111. The hemlock in Saint Lawrence County is cut primarily for lumber, and at a season when the bark can be readily secured, say from the middle of June to the 1st of September.
112. Supplies of bark are obtained in small quantities, over a large area, and much of the hemlock is a second growth. The timber is all saved.
113. The timber from bark peeled furnishes about 100,000 feet of lumber, and 2,000 to 5,000 cords of wood.
115. Hemlock bark is very scarce in this vicinity, and supplies have to come from about 70 miles.
120. The yield of bark in this (Sullivan) county was estimated at about six cords per acre, taking the hemlock lands generally through the county; but now the bark is nearly all used up and the tanners are locating in northern Pennsylvania. Bark for shipping is worth \$6 a cord. There is only one large tannery now running in the county, and that will be compelled to stop in a year or two. There will still be one small sole-leather tannery in operation, that may run for a few years on bark drawn from a long distance.

121. We do not find the oak bark of this region profitable so long as we can get hemlock at \$5 per cord. It is getting scarce every year.

122-127. The timber generally used; but little wasted.

128. The bark is now taken cleaner from the trees than formerly. We estimate that 10 per cent. more is saved than ten years ago. The returns represent three tanneries, about equal in consumption.

129-132. Lumber is scarce, and it is all saved.

132. This tannery will soon be abandoned, as the bark in this vicinity is nearly all gone.

134. The timber is all saved. No efforts are being made to grow bark, and the hemlock forests are fast wasting away.

135. The hemlock bark is peeled more closely than years ago, but otherwise nothing is done to economize. The lumber is saved.

136-138. The lumber is all saved.

139. Bark is obtained from New York. There is no oak or hemlock in this vicinity. The latter is nearly exhausted on the Green Mountains, in the region from whence our supplies come.

141. This section was originally filled with small tanneries some fifty years ago. Now there is not one where there were twenty-five then. No timber is cut for bark, but all is used. The hemlock does not endure civilization.

NORTH CAROLINA :

1. Most of the timber is left on the ground.

2. The timber is generally used for fire-wood. There is a large amount of sumac growing in this vicinity that might be used in tanning; but it has not been hitherto used.

3. From sixteen to twenty oak trees are peeled to the acre, the wood being generally used for fencing and fire-wood. Sumac is growing in the vicinity, but is not used for tanning.

4. Nothing has been done with reference to the future, but something must be done. Bark is getting scarce in this vicinity.

5. The trees cut for peeling are not generally used. The supply has about given out in this vicinity. No sumac is collected or used.

7. The wood is not generally saved.

8. Bark is generally saved where people are clearing land, and it is used for rails.

9. Most of the timber is saved for lumber, and the tops for fire-wood. The mode of tanning practiced is expensive, and economy is necessary. Sumac grows in large quantities, but is not used in tanning. The probability is that tan bark will command an advanced price in the future.

10-11. The timber is used for lumber, rails, or fire-wood.

12. Business has been carried through three generations. We never allow a full-grown oak to be cut for any purpose except in showing when the bark will peel. We cut out the trees which show signs of decay, and preserve the forest as much as possible. At the present rate our supply will last many years. More bark has been destroyed by cutting timber for rails, &c., in this section than has been used.

13. The supply of bark is irregular, and comes from farmers as they may wish to cut their timber for rails.

14. The stock law is now in force in this county, which will be a great saving of timber, as it leads to the taking up of timber lands to form stock farms. The most of our forest timber is oak, and, with care and economy, it will last a long time, unless we are drawn upon to supply other localities.

16. About a fourth part of the wood is used. But little sumac grows in this vicinity, and none is prepared for market.

17. The timber is used for fire-wood. No sumac is collected.

18. Bark is brought from 20 to 30 miles.

19. Timber generally used; no sumac is used.

20. Wood mostly left on the ground; good bark for tanning is getting quite scarce, and much of it is hauled from 5 to 8 miles.

22. Timber mostly used for fire-wood.

23. Three-fourths of the timber is saved. The bark is much wasted.

24. Bark is of minor importance in our section (Wake County), there being no bodies of forest from which it is obtained. A few trees are cut on one farm and a few on another. A tree 3 feet in diameter and of medium height will yield a cord of bark. The timber is generally saved.

OHIO.

1-3. The timber is all saved for sawing, or is cut into fire-wood.

4. The timber (hemlock) is mostly saved for lumber and shingles, the yield being about 2,000 feet to a cord of bark. There is nothing in this region that can supply the place of this bark, and a few years will close up the business in Northeastern Ohio, very little sumac grows in this vicinity, and none of it is used.

5. The wood is all saved for charcoal and mining purposes. The bark (chestnut oak) will not last over twenty years in Southern Ohio. It is getting scarce in this part of the country, as in fact is all timber.

6. The white oak is sawn into lumber. It is evident that the future supply will be scarce and high priced, unless measures are taken to plant oak.

8. Timber all used.

9. There is much white and black oak in this region (Champaign County). The chestnut oak grows in the southeastern counties. It takes a long time to exhaust a country of bark and timber, and it will last very much longer than many suppose.

10. The timber is usually left to decay. No bark is got from this vicinity; it comes from the hilly country of Ohio, or the Upper Ohio River, or from Kentucky and West Virginia. The supply is fast going, and no care is taken in replanting.

11. The timber is all saved for staves, rails, ties, and chair-stuff. There is a large amount used in the manufacture of splint-seat chairs, and the timber is being destroyed at a fearful rate for that purpose, and for railroad ties.

12. The timber cut for bark in this region is generally not fit for other uses than fire-wood. A considerable amount of bark has been shipped from this section during the last three or four years, chiefly to the Northwest.

13. The processes employed for tanning are wasteful, in some cases half of the bark being lost.

14-19. The timber cut for bark is all saved.

20. Timber used. The large oak trees are being cut for ship-timber, which is causing the destruction of a great deal of bark throughout this section of the country, and tends to raise the price of bark, as it reduces the supply.

21. Sumac grows here (Fairfield County) plentifully, and of good quality, but it is not gathered. A great deal of bark is wasted by the farmers by their not cutting the trees at a proper time, or they allow the trees to stand too long after they are killed, and this prevents a new growth, which would produce bark in ten years. There is a fine opportunity here for some enterprising man, in gathering sumac.

23. The trees (chestnut oak) are mostly used for railroad ties. Bark is shipped here (Franklin County) from Pike, Scioto and other counties.

24. The timber is all used, mostly for railroad ties. Something must be done for bark in the future in this county. [The correspondent's father was a forest officer in Germany, where special attention was given to the growing of bark. The trees were cut every thirteen years.]

25. The chestnut oak is generally used for fire-wood, it being generally too crooked for other uses.

26. The timber is saved. There has been a great waste, but the farmers are beginning to be more careful. It is becoming scarce in many parts of the country. None is planted but for shade in towns, and this is generally hard maple.

27. Timber generally saved for rails and fire-wood.

28. The department should see to it that the chestnut oak is replanted. If this is not done the tanning industry of the country will die out.

31. The timber is mostly left to decay.

33. Timber mostly used up for railroad ties.

34. Timber mostly used. Hemlock bark has been shipped from Michigan. The white-oak bark (the only kind used here) is about all used up, and the timber is becoming very scarce.

35. The timber, so far as sound, is used for rails.

36. There is a plenty of white oak, but as the yield for tanning is only about one-half that of chestnut oak, there is not much of it used.

37. The timber is being cut and taken to the railroad, at a season when the bark cannot be saved. The supply of bark has been so nearly exhausted in this part of Ohio that most of the tanners have been obliged to quit the business or to use extracts.

38. Nothing growing in this region will tan leather but black and white oak, and the former is all gone.

41. The wood is all used for lumber and fuel. A considerable amount of forest is being cleared in this vicinity, first, because the owners do not like to pay taxes on so much unproductive land, and, secondly, because much of the timber is beginning to decay.

42. most of the wood is used for staves and fence rails.

43-47. The timber all saved.

48. The sumac in this vicinity is all exhausted long since. The owners of timber land should be advised to be more saving in the supply.

49-50. The timber is saved.

51. The hemlock bark used comes from New York and Pennsylvania. All of the oak timber is saved, but nothing is done to increase the production. Tan barks in this vicinity are about "played out," and no oak timber is cut unless the wood is wanted for some use,

52. The timber is used.

53. The timber furnishing bark is found only on the highest points and ridges, and, when cut, the wood is all used. Timber is disappearing rapidly, the steam saw-mills and railroads using it up very fast.

54. The oak timber is generally used for staves.

57-58. The timber is all used.

59. Bark timber is only found in this county (Noble) in small quantities, and on ridges. There are probably not more than fifty acres in the county, yielding about twenty cords to the acre. The wood is used. It is highly important that information should be gathered upon the subject of future supplies in this industry.

60. The timber is being rapidly destroyed, and conservative measures are becoming every day more important.

61. There is a great deal of oak timber cut for railroad ties and staves, and much timber is wasted. Farms are being bought up, and the timber is being cut off for these uses, which will soon leave the region destitute of bark supplies.

62. Bark is procured from other localities.

65. A great deal of timber is left on the ground.

66. Much timber is used for railroad ties, and some goes to waste. The bark used in Ross County comes chiefly by canal and railroad from a distance. The southern portion of the State has been a good bark country, but it is being rapidly exhausted.

67. The timber is being all used up for staves, lumber, and fire-wood. Trees should be planted for future use.

68. If farmers would cut their timber when it would peel there would be enough for local use, but it is generally cut in winter.

70. The wood is used. For local tanneries the supply appears to be enough for the next fifty years. Those that do a large business; will have to move to where bark is plenty and cheap.

70. The wood generally used for rails and fuel, but sometimes it is wasted.

73. Timber sawn into plank and railroad ties.

74. Most of the wood is left to decay on the ground.

75. Timber mostly left to decay, excepting a part used for rails.

76-77. The timber mostly saved.

78. The greater part of the timber is not peeled, because there is so great a demand for lumber in the construction of railroads, that it is not saved. Portable saw-mills are being moved all around through the fall and winter, and the prospect of higher prices for bark are becoming greater every year.

79. The timber is about all saved.

80. The timber is all used. There is no hemlock bark in this region, it is brought from Michigan.

81-82. The timber is all saved.

83. Beech and hickory barks afford tanning material, but the leather made from the former is stiff. That from hickory is softer, and from willow a soft nice leather is produced, but the strength of this bark is small.

[One establishment in Ashland County had discontinued, owing to the competition of hemlock tanneries and the exhaustion of supplies. The timber had been cut and wasted till none remained upon which dependence could be placed for a supply.]

OREGON.

1. The timber is red and yellow fir, and excessively abundant.

3. It is rumored that a large tannery is to be started here by a San Francisco company. If so the supply of bark will last but a few years, as so little care is taken to protect it.

4. The hemlock of this region is not in large bodies, but is scattered and only found in small patches. If it occurred together, the yield would be about 120 cords to the acre. The fir would yield much more bark, but we use it only from trees about twenty inches in diameter at the butt. The moss is too thick on the heavier timber. The hemlock of this country is only found on the mountains, but it is left to rot. There is a plenty of fir, and it makes much better lumber.

5. The fir forests are abundant, but they yield a very mild bark. Some tanners have imported extracts, for the purpose of making stronger liquors than can be made from our barks. Large tracts of land are now covered with firs from 4 to 18 inches in diameter, that were entirely destitute of timber 35 years ago. The hemlock is not thus spontaneously produced.

6. The forests of hemlock are heavy. This timber is seldom used, but the firs and oaks are generally used.

PENNSYLVANIA.

1. The trees are generally saved for wood and lumber.

2. The timber is generally used. Nothing is employed for tanning purposes but rock-oak bark, and nothing has been done to enlarge the production by planting or

otherwise. There is a small quantity of sumac used by the tanners here (Adams County), but none is shipped.

3. The supply of chestnut-oak bark within a hundred miles of here (Pittsburgh) has decreased so much that we have to look for our supply to West Virginia, Maryland, and a small part of Pennsylvania along the line of the Baltimore and Ohio Railroad, Pennsylvania Railroad, and the Ohio River.

4. But little timber is allowed to decay. The supply of bark will probably last for a long period.

5. The bark within a hundred miles is exhausted, and our main supply comes from further points, principally from the Allegheny Mountains by rail, and by the river from West Virginia. The timber is mostly saved, the greatest loss coming from the cutting of woodlands for clearing, when there is no market for the timber. It is our opinion that the bark supply of Pennsylvania will be exhausted within fifty years, as there is nothing growing that will take place of the timber cut down. The annual consumption of bark is very large; no means have been taken to economize, nor has a substitute been devised. No sumac is gathered in Western Pennsylvania, the supply being obtained from Maryland, Virginia, and Tennessee.

In view of the great destruction of timber in this country, grave and serious questions will sooner or later arise concerning the future supply of timber and bark, upon which so many important industries owe their existence. The only remedy is the cultivation of forests, and as private enterprise would hardly engage in this very important matter, it behooves the different State governments, under the systematic direction of the general government, to enact such laws as will bring about the desired result. There are now many barren hills in Pennsylvania unfit for agricultural purposes, that could be bought by the State and changed into forests.

8. Timber is not cut for peeling faster than it is wanted for use.

10-11. Timber generally saved.

13. Of 140,000 trees, about half are saved. Where accessible, the timber is used for railroad ties and for sawing.

14. Timber mostly used. It is cut to clear the land for farming. More care is taken now than formerly in leeching and grinding the bark, and in sheltering it from the weather. A large amount of tanning is wasted by exposure and bad management. Forest fires destroy a large amount of bark every year. If the small trees were carefully protected the oak lands would furnish a continuous crop. Thus, for instance, 4,000 acres of oak-bark land, properly protected and managed, would yield 1,000 cords of bark per annum for all time. In 1862, in Perry County, a number of acres were cut in that way (taking only the large trees), and within five years there has been taken six cords per acre from the same ground. There were, however, hundreds of acres there which could not be protected from fire, and the future supplies from these burned districts were lost. The hemlock bark will not reproduce itself.

15. The timber is used for rails and wood.

16. A very large part of the timber is not used. Supplies will last eight or ten years. In this region (Bedford County) the rock oak is well suited to the rolling upland, and it has been regarded as a fine bark region. This has influenced the location of a large number of tanneries in the upper half of this county. On some slopes there is an undergrowth of oak that will in time produce another crop "in the lifetime of our boys."

17. The timber is generally used. The prices of bark at our railroad station have been from \$1.50 to \$2 in advance of us each year.

18. Timber all used for railroad ties, planking, and cord-wood. Small quantities of sumac are collected and sent to Morocco and sheepskin tanneries in Philadelphia.

19. We need a law protecting our forests from being cut until the timber is of a certain age.

20. Most of the bark comes from over a hundred miles. In this vicinity only a few single trees are generally barked, and only in very small tracts. The wood is generally saved. Woodland is becoming gradually scarcer.

21. The timber is all used. Bark is very scarce in this vicinity (Reading), and, if dependent upon the home market, a few years would exhaust the supply. Within a short time it will be found necessary to resort to the remaining wild land in the State in order to continue the business of tanning.

22. The timber is used for saw-logs, railroad ties, and cord-wood.

23. All of the timber suitable for lumber is used. The sumac growing in this vicinity is of no account, and is not collected.

24. The timber is generally used either for rails, cord-wood, or railroad ties. There are three large tanneries in this vicinity (Bedford) which together consume about 1,600 cords of chestnut-oak bark annually.

25. The timber is generally used. Cannot estimate the length of time the available supply of bark will last, as large quantities are shipped to other points.

26. The timber is generally used for lumber. Sumac is quite abundant in this vicinity, but it is not collected.

27. The timber is manufactured into lumber.
28. The timber cut for bark is all used.
29. The timber cut for bark is all used for lumber.
30. The timber cut for bark is generally used.
31. The timber cut for bark is used for lumber. Sumac grows abundantly in this vicinity (Bradford County), but is not collected. About 4,000 cords of hemlock bark were shipped by railroad from Wyalosing during the past summer.
32. The timber cut for bark is generally used.
33. The timber cut for bark is all used for cord-wood and sawed timber.
34. The timber cut for bark is all used. Sumac is very scarce, and is not collected.
35. The timber cut for bark is all used for lumber. Sumac grows in this county (Camden), but is not collected. The bark supply in this vicinity will be entirely exhausted within two years. There are but few timber lots left, and lumber is in good demand. If tanning is longer continued in this county, bark will have to be imported from other localities.
36. The timber supply is about exhausted. All of that cut for bark is used for lumber.
37. Probably one-half of the timber cut for bark is left upon the ground to decay. The yield of timber is from 1,000 to 2,000 feet per cord of bark. The bark supply will last many years, if economically used, fires prevented, and it is not shipped to other places. Much hemlock is destroyed by fires carelessly set in burning fallows and by hunting parties.
38. The timber cut for bark is used for railroad ties.
39. The timber cut for bark is used for lumber.
40. The timber cut for bark is generally used.
41. Bark timber is scattered, and it is impossible to estimate the yield per acre. The timber is generally used.
42. The hemlock timber is generally used for lumber. The oak is burned in clearing the land. Sumac grows along the Clarion River, but it is not used for tanning purposes.
43. The timber cut for bark is used. Large quantities of bark are shipped. Oak is still abundant. Sumac is abundant but is not collected. A young growth of birch timber is taking the place of the timber cut for bark. Several large tanneries are being erected.
44. The timber cut for bark is mostly used.
45. The timber cut for bark is all used for railroad ties and other purposes. Sumac is abundant, but is not collected.
46. The timber is generally used. The bark supply is being rapidly exhausted. The oak timber would reproduce itself were it not for forest fires.
47. The timber is generally used.
48. The timber cut for the bark is all used. About the same quantity of bark is shipped as is used here for tanning.
49. Three-fourths of the original timber supply in this vicinity has been cut off. The timber is cut for *lumber*, and none for bark merely. Less than one-half of the hemlock timber is peeled. An excellent tanning extract is made from chestnut wood and roots. Sumac grows abundantly but is not collected.
50. The timber is used for lumber and stove-wood.
51. The timber is all used for lumber. The hemlock is mostly owned by farmers who have their wood lots reserved, and only cut it as they need the timber for building purposes. Some of the timber lands are held by speculators, for higher prices.
52. The timber cut for the bark is generally used.
53. All of the timber that is accessible is used; the tops generally go to waste for want of market. White, Spanish, black, and chestnut oak timber grows in this vicinity, but it does not pay at present prices to use the bark for tanning. Sumac was formerly collected here for tanning, but is not at present. The quality is not as good as that grown in Virginia. Much valuable timber is destroyed by fires carelessly set by locomotives, and in clearing land.
54. The timber cut for the bark is generally used.
55. All honor and praise to you for the initiatory steps you have taken in regard to the tanning industry. I desire to call your attention to the economic use of the bark used in tanning, after it has been produced and peeled. There is an immense loss and waste in the use of bark after it is peeled, and I would classify that wastage under the following heads, viz: curing of the bark, grinding, leaching, and decomposition of bark liquor after it is leached. All of the above subjects would deserve an investigation by the chemist of your department. My experience in the curing of bark is that it is the lightest and produced the best liquor when it is piled in the shed before it is quite dry, or, in other words, before it is very dry. This is similar to the improved process of curing and drying tobacco. In grinding great advantages are claimed by cutting machines. It is evident that coarsely-ground bark cannot be leached well especially if the leaching is done with cold water.

I described a new process of leaching in the "Shoe and Leather Reporter or Trade Journal," of June 9, 1881. The process of using 212 degrees therein described is an innovation upon established usage, but up to the present date it has proved to me to be a great improvement over my former method, and I think it is worthy of general adoption by the craft. There is a great loss in bark liquor by decomposition and fermentation, or chemical change of the liquors. This change is greatest in warm weather. In combining the tannin of the bark with the gelatine of the hide, it is demonstrated that there is a great loss of tannin. This loss is accounted for mainly in the fermentation of the liquor, and by imperfectly extracting the tannin in leaching.

The extract matter or liquor of the bark is composed largely of coloring matter; it is my opinion, sustained by experience and observation, that *the gelatine of the hides takes up of this coloring matter in equal proportion to the tannic acid that is in the liquor, and becomes a component part of the leather*, so that in making up the amount of tannin that is combined with the gelatine of the hide, the coloring matter in the liquor should be taken into the account. And it should be remembered that tannic acid in crystals is a colorless substance.

For the chemist to make an account of the loss of tannic acid by exposure to air, he should take equal quantities of bark liquor of equal strength, and leave the one exposed to the air, and have the other hermetically sealed; this would decide the matter as to the loss of tannin by exposure to air; but in making such an analysis, the fact that the amount of tannin contained in oak bark depends very largely upon the soil and climate in which it is grown should be taken into account, and I am of the opinion that the chemical change that takes place in the use of hemlock-bark liquor is small as compared to the loss in the oak barks; especially in rock or chestnut oak, it is the greatest.

Five years ago I experimented with a barrel of liquor by putting a small quantity of sal or washing soda into *strong new liquor*, to neutralize the acid, and to prevent its fermentation. I tanned ten calf skins in it in two weeks, and had a pair of boots made of one of the skins for my own use, and wore them three successive winters. The leather was rather dark, but very pliable and soft. But the process would not answer for sole leather, where solidity is required. I did not repeat the experiment, but I desire that the chemist of your department would make a practical test of it on a small piece of hide for the benefit of the craft.

In addition to the above, this report shows the following: The yield of bark is greatest at the base of the mountain ranges, as the trees are larger and more abundant. It is also true that the trees are larger and the yield greater where there is running water or moisture. At least three-fourths of the timber cut for supplying my establishment with bark is left upon the ground and allowed to decay. There is nothing in which there is so much prodigality as in the timber peeled for the bark that is left to lie and rot for want of a market. By taking portable engines and saw-mills into the mountains, and boring and drilling wells to get a supply of water, the most of it might be converted into lumber and sold at a good profit.

56. The timber cut for the bark is used. The sumac growing in this vicinity is collected.

57. The timber is all used for lumber.

59. The supply of bark timber in this vicinity is being rapidly exhausted. The trees cut are generally used for lumber, railroad ties, and cord-wood.

60. The timber is generally used for railroad ties, fire-wood, and charcoal. There is some sumac collected in this vicinity, but we cannot state the amount. We would suggest that the United States Government adopt some plan to stimulate the people owning timber land to plant chestnut oak and hemlock trees where cleared off. As yet nothing has been found that will answer as a substitute, and produce the same result.

61. All of the timber is used in the mines. The mountains in this vicinity have been cleared of timber for use in the coal mines in the valley. The young timber or sprouts would in time become more valuable than the original crop, were it not for the fact that thousands of acres are burned over annually, and the sprouts and young trees destroyed. The fires are set by parties who herd cattle in the mountains, and who set fire to the leaves in order to allow the grass to grow the year following. Many of the fires are also set by tar burners in order that they may the more readily find the pine knots, and in this manner thousands of dollars' worth of timber is destroyed for a few barrels of tar. If the fires were kept out and the sprouts trimmed up, it would require but a few years' time to cover these mountains with a fine growth of timber.

62. As a rule the timber is used.

63. About one-fourth of the timber cut for supplying this establishment with bark is left upon the ground to decay. The amount of timber thus annually wasted would yield four million feet of boards. Bark should be more thoroughly leached, and greater care taken in peeling in order to save all of the bark that is practicable. The amount of sumac collected here will not exceed ten tons annually, and all that is collected is used here.

64. The timber is used for lumber.
65. About one-half of the timber is used. A small quantity of sumac is collected for home use.
66. The timber cut for supplying this establishment is generally used for lumber and wood. Steps should be immediately taken to secure legislation preventing large companies from peeling thousands of cords of bark and leaving the timber upon the ground to decay. This is now being done extensively along the Philadelphia and Erie Railroad. This timber will all be needed within a few years' time, and it will cost the country a vast sum to replace it.
67. The timber is all used. Every State in the Union should have reserved tracts of timber land, which should be under the charge of educated forestry men, and in the season of bark peeling only such trees should be selected and cut as do not show a rapid and healthful growth, or would soon die of old age, and their place should be filled with young plants of the same kind.
68. As a rule the timber cut for bark is used. A law should be passed prohibiting the cutting of young trees.
69. Most of the timber is used for lumber.
70. The timber is nearly all used.
71. A large portion of the timber cut for the bark is allowed to decay upon the ground.
72. The timber is used.
73. The timber cut for bark is used. The bark supply in this county (Fayette) is about exhausted. That still remaining is difficult of access. The ground cut over is rapidly growing up to young timber.
74. Twelve hundred trees are wasted annually.
75. The timber is used. About one-fourth of the bark used by us comes from this immediate vicinity. The remainder is from the mountains 20 to 30 miles distant, and from West Virginia. The bark supply here is becoming scarce and cannot be depended upon.
76. The timber is not generally used.
77. From 600 to 1,000 trees wasted annually. The supply is being exhausted in this vicinity, though we have a mountain range to depend upon for a supply.
78. The timber cut high up in the mountains is left upon the ground to decay. Bark timber grows rapidly in the mountains but is frequently injured by fires. Sumac was formerly collected in this vicinity but has not been saved for several years past.
79. Between 3,000 and 4,000 trees left upon the ground to decay annually. In this vicinity, embracing a radius of 15 miles, the bark is rapidly disappearing, tanning having been carried on extensively for the past thirty to forty years. Ridge land is being cleared. Mountain land will not reproduce, owing to the frequency of the burnings. An annual supply of from 500 to 700 tons of bark can be obtained within 17 miles of the railroad for many years to come. A large quantity of sumac is collected and shipped to Hancock, Md.
80. Timber that is conveniently accessible is used. Sumac is collected and shipped to Hancock, Md.
81. Small quantities of sumac are collected and shipped to the Baltimore, Md., market.
82. Three hundred cords of wood, 2,000 railroad cross-ties, and 50,000 feet of lumber wasted annually. Sumac grows abundantly, but is not collected. The forests of this State are very rapidly being cut down. The tanneries require an increased amount of timber in order to furnish their supply of bark, and it is safe to predict that from 50 to 60 per cent. of the timber cut is wasted. There will need be national legislation before many years, such as will prohibit the recklessness in the destruction of timber, as well as to cause the planting of young trees in order to maintain the future supply.
83. The timber is used for railroad ties.
84. The timber is generally used.
85. The timber cut is all used for domestic purposes. Most of our timber lands are in the mountains and are being rapidly cut away. The timber grows spontaneously, though it will require many years to grow.
86. The timber cut for the bark is generally used for rails.
87. As a rule the timber is used for railroad ties. The bark supply is being rapidly exhausted. Much of the land from which the timber and bark has been taken lies useless, while with a little attention it would soon become productive. Where trees are taken others should be planted in their stead.
88. The timber cut for the bark is generally used. There is much spruce bark wasted here annually, owing to the low price paid for it.
89. About half of the bark of timber cut is used. The State must protect our forests soon or suffer great loss in one of its staples.
90. The timber is generally used.
91. Timber is all used for lumber. Hemlock and oak bark have only been used

in this county (Jefferson) since 1876. The largest portion of the bark is shipped to Pittsburgh and other points east.

92. Most of the timber cut is wasted, on account of the distance from railroad and market.

93. The timber is all utilized. We deplore the wanton destruction of forests in the tanning and other interests, and hope some way will be found to remedy the existing evil.

94. All of the timber cut is used for railroad ties and lumber. The small limbs of the chestnut oak, we think, could be used with profit in tanning.

95. The timber is generally used. Sumac grows abundantly, but has not been collected during the past twenty years. If the forest or mountain fires that occur almost every year could be prevented, bark would grow on the mountains as fast as required for use. Much timber is used for wood without peeling.

96. Most of the timber is used for railroad ties. There are two varieties of sumac growing in this vicinity in considerable quantities, but it is not used.

97. The timber is used for railroad ties. There is an abundance of bark in this valley. Rock oak is most used. During some years 2,000 cords of bark are taken to Port Royal station from this valley.

98. The timber is all used for lumber.

99. All of the timber is used for lumber.

100. The timber is generally used. Bark is becoming scarce in this vicinity; two-thirds of the bark used in this establishment are shipped from other counties, and from Virginia.

101. Much hemlock is still standing, but large tanneries are being erected which will consume from 10,000 to 12,000 cords of bark annually, and owing to the scarcity of hemlock in Pennsylvania, excepting three or four counties from which the supply must be produced, it will not require many years to exhaust the bark supply in these prolific counties.

102. The timber is all used.

103. All of the timber is used for railroad ties and for fire-wood. There are places throughout the county where timber should be cultivated, especially upon lands that can be used for no other purpose.

104. All of the timber cut in this county is used. No tanning material is wasted. No steps have as yet been taken to produce it, except where bark timber is protected in its second growth on such lands as are not desirable for tillage. Very little sumac is collected for home use; there is none shipped. Since 1875 we have purchased bark by weight (2,000 pounds per ton). The bark supply is from the mountain counties of the State. Rock oak is principally used in this county.

106. The timber is generally used. The timber in this immediate vicinity is very scarce. That remaining is principally black oak, white oak, hickory, and locust. It will soon be found necessary to start forests for future use.

107. There is very little timber cut in this vicinity.

108. Very little timber land in our county. Our bark supply comes from western counties.

109. The timber is used for fencing and lumber.

111. No timber land. Bark is brought from a distance.

112. The timber is mostly used for car lumber.

113. About 300 trees wasted annually.

114. The timber is all used.

115. Much of the timber cut for the bark is wasted. Shipping bark to Europe should be prohibited, as the supply is being rapidly exhausted.

116. The timber cut for bark is all used for lumber.

117. The timber is all used for lumber.

118. The timber cut in this vicinity is all used.

119. Timber is all used for lumber.

120. The oak timber is used for railroad ties, and the hemlock for lumber. No methods for economizing in the use of bark have been used in this county.

121. The trees cut for bark are all used for lumber.

122. The timber is all used for lumber.

123. All of the timber is used.

124. Rock oak is only found upon ridges and in the mountains. This is much more of a hemlock country. The valleys of Pine Creek, Lurys Creek, Lycoming Creek, Loyal Stock Creek, and Murrey Creek produce a large supply of hemlock. While the intention is to save the timber, fully one-half of it is destroyed by fire. The supply of *white pine* timber has been about exhausted in this county. Where the pine has been cut away, allowing the sunlight to reach the roots of the hemlock, the result has been that the hemlock has died. Considering this dying out of the timber, the destruction caused by forest fires, and the natural consumption, it is safe to estimate that the bark supply will be exhausted within 10 years. Sumac grows abundantly upon lands that have been burned over, but it is not collected.

125. The timber is used.
126. All of the timber is used.
127. The timber is generally used.
128. The timber cut for the bark is used.
129. The greater portion of the timber cut for the bark is used.
130. The timber is generally used.
131. About two-thirds of the timber is used, and one-third or about 2,000,000 feet, wasted.
132. All of the timber that is peeled is used for lumber.
133. Much of the bark of timber cut in this vicinity is never utilized for tanning purposes.
134. The timber cut for the bark is used for railroad ties and for car timbers.
135. The timber cut in this immediate vicinity is all used.
136. None of the timber is wasted. No methods for economizing the materials or enlarging the production have been employed. Our hemlock forests are being rapidly exhausted. Much of the timber is annually destroyed by forest fires, and unless legislation is soon had in the premises, we will soon want for timber. Oaks and chestnuts attain a considerable size in twenty years' time, providing a little attention is given them.
137. Sumac was formerly collected in this vicinity and shipped to Philadelphia, but has not been collected for several years past. It is merely a question of time before bark will become a scarce article. In the hemlock districts, where it is most abundant, the price paid for bark during the past year, was \$1.50 per cord, more than ever before. "In my opinion the tanners have had their best days, and unless there is less cutting down of forests, or more planting, the tanners will be situated as the English tanners are, who are paying from \$30 to \$40 per ton of 2,240 pounds, for bark, and who depend upon America to a great extent for all kinds of oak bark for tanning." Tree planting should be encouraged.
138. There is very little bark peeled in this vicinity. All of the timber cut is used. Heavy tanning is virtually ended in this locality; extracts and chemicals do not seem to produce a prime article of leather, excepting for certain kinds of light stock.
139. One-half of the bark is wasted, as the trees are cut at a season of the year when the bark is worthless.
140. None of the timber is wasted, as it is cut only as needed for use. Nearly all of the tanneries in this section have closed on account of the scarcity of bark.
141. The timber cut for bark is generally used for railroad ties or lumber.
142. There is very little bark peeled in this vicinity. All of the timber is used.
143. Most of the timber is used.
144. There are no large timber tracts in this vicinity, and all the bark that is obtained is taken from timber culled out of the woods for making railroad ties and for general use. The timber is all used. The enormous quantities of timber that are being taken for railroad ties and car lumber is rapidly stripping the country of its wood. No forests are being planted in this section as lands are too dear.
145. All of the timber is used.
146. The timber is used for railroad ties. Large quantities of bark are shipped to other places.
147. The timber is used for the manufacture of cars, railroad ties, planks, building material, and fuel. Nearly 20,000 trees per year are required to supply this establishment. The hemlock is mostly shipped by rail from Lycoming County. Persons owning timber lands know the value of the bark, and are allowing the young trees an opportunity to grow by cutting the old ones. This is a mountainous country, and if the fires could be kept out the bark supply would last for many years. With care oak-bark trees, or chestnut-oak trees will reproduce the same. Have known tracts thus cared for to produce more bark after standing twenty years than was originally taken off both for bark and timber.
148. The timber is generally used for railroad ties and props for mines. Sumac grows in abundance, but is not collected. Bark is being rapidly consumed, and large quantities are shipped annually.
149. Timber is about all used.
150. The timber is generally used.
151. The timber is used for railroad ties and lumber.
152. Nearly all of the timber cut for supplying this establishment with bark is left upon the ground to decay. The amount wasted is not less than 13,000 tons of cord-wood. A very little of the timber cut is used for railroad ties. "The only mode of economizing bark that we can find is to adopt the best modes of grinding and leaching it, for which purpose we use Barber's, Allentown mill, and improved circulating leaches of simple construction, and we cover our vats to prevent evaporation. The patents obtained throughout Europe and in the United States, by Paul Gondalo, of Paris, for the manufacture of his improved process of pure liquid tannic acid or tannin are liable to work a revolution in the tanning interest. The wood of the ordinary chestnut tree

growing nothing but briars and scrubby bushes, it seems to me as fit a subject for legislation, with a view to replanting them with hemlock, as so much legislation on stocking our rivers and streams with fish, inasmuch as very much of this land is too rough to utilize in any other way."

179. The timber is used.

180. The timber cut recently has been utilized. It was formerly left upon the ground to decay. Steps should be taken to prevent forest fires. The acorns should be collected and planted, and tree planting should be promoted throughout the country.

181. The timber cut is generally used. "The destruction of timber by forest fires will average ten per cent. of the timber annually. These fires could in a great measure be avoided if settlers would exercise proper precaution, and burn their fallows at proper times."

182. Thirteen million five hundred thousand feet (board measure) of lumber is annually left upon the ground to decay.

183. The timber is all used or manufactured into lumber.

184. The timber is generally used.

185. Timber is used. Forest lands are taxed too high, and no one can afford to hold them. Laws are not strict enough to protect wild lands from fire.

186. The timber cut is all manufactured into lumber and shipped. Sumac is abundant, but is not collected.

187. The timber is used for lumber.

188. Most of the timber is used for railroad ties, and a portion of it for lumber. Much of the young timber is destroyed by mountain fires.

190. The timber is generally used.

191. All the timber is used.

192. Sumac grows abundantly, but is not collected. The timber cut for bark is generally used.

193. The timber is used for lumber. This is a farming country. The bark used in tanning is purchased in small quantities from the farmers. There are no large tracts of hemlock timber available.

194. The trees are all used for lumber.

195. The timber peeled to supply this establishment is all manufactured into lumber. "Within a radius of 10 miles from this place (Warren County) there is probably 50,000,000 feet of hemlock timber left upon the ground to decay annually."

197. The trees are all used for rails, lumber, and fire-wood.

198. Five million feet of lumber is wasted annually.

199. The trees cut for bark are all manufactured into lumber, and shipped to New York City.

200. The timber is all used.

201. Nearly all of the timber is used.

202. The timber is all used.

203. The timber is generally used for railroad ties and laths. "The forests are being rapidly destroyed, and some measures should be adopted to keep up the supply for future generations, as is done in old countries. A tree should be planted for every one that is cut down."

204. The timber is generally used.

205. The trees are generally manufactured into railroad ties and lumber.

206. The timber is used.

207. Nearly all of the timber is manufactured into lumber.

208. The timber is all used for lumber and fire-wood.

209. None of the timber is wasted.

210. The timber is generally utilized.

211. The timber is generally used.

212. The timber is used for fire-wood and saw-logs.

213. All of the timber is used for fire-wood, &c.

214. All of the timber is used.

215. Very little of the timber is wasted. Most of the timber lands in this section of the country is owned by the South Mountain Iron Company.

SOUTH CAROLINA.

2. About one hundred trees are wasted annually. "As a tanning agent the sweet-gum briars produce an exceedingly tough leather, though it is of a darker color than that produced from oak bark."

4. The timber cut for the bark in this vicinity is manufactured into fire-wood for the city market. Up to the present time we have been able to obtain an abundant supply of bark in this immediate vicinity, though the greater portion of it has consisted of red and black oak, which is not considered the best for tanning.

5. About 600 trees are allowed to decay upon the ground annually.

6. One hundred trees are wasted annually.

7. The timber is generally wasted. "The introduction of improved machinery in

has been proven to contain a percentage of pure tannin, nearly equal to that of rock oak bark, and in France and Austria, where large factories have been established for its manufacture, the sale and use of it have been very widely extended and successful. Owing to the great purity of tannic acid so made, its efficiency in converting raw hides into leather, either alone or in combination with bark liquors, has been proved to be very great, and it results in an increased plumpness or thickness of the leather and enhanced gain or yield of weight, as well as considerable increase in the rapidity of the process. The company formed in this country is erecting works at Huntingdon, Pa., on the grounds of the Pennsylvania Railroad Company, and expect to be providing their tannin by the twelfth month (December) next. Our own experience in its use has been so far limited, but has convinced us of its very great value as a medium of making good and genuine leather, in all respects equal to what is produced by bark alone, and we expect to use it extensively."

153. The timber is used for wood and lumber. The bark supply is still very abundant.

154. The timber is generally used.

157. The bark used for tanning in Philadelphia is mostly obtained from the interior of Pennsylvania. Some Spanish oak bark is obtained from Delaware, but not in large quantities. Large quantities of bark are annually wasted by improper care and carelessness in curing.

158. The timber is all used for lumber, &c. "The supply of hemlock and oak bark is about exhausted in the counties of Wayne and Pike. Tanneries are being abandoned. Hemlock extracts cost 4 cents per pound; oak, 6 to 7 cents per pound, and terra Japonica, 5 cents per pound. All of them are inferior to bark for tanning purposes and cannot be used in the manufacture of sole leather with profit. The quality of the leather manufactured by these substitutes is very inferior, soft, and spongy, and deficient in weight and very objectionable in color. I have used all of them and with very unsatisfactory results."

159. The timber is all used. The bark supply is nearly exhausted in this vicinity.

160. The trees are cut for the timber.

161. All of the timber is utilized. The laws prohibiting the setting of forest fires should be strictly enforced. Were it not for the destruction of timber by fires, the hills and mountains in this locality would furnish an abundance of timber. There is very little sumac growing here, and that is of an inferior quality.

162. The timber is utilized, excepting in cases where it is distant from the railroad. None of the timber is cut for the bark alone. It is cut for railroad ties, and other purposes. This is a coal mining county, and there is very little tanning done. The price of bark has declined since the close of the war.

163. The timber is all used for railroad ties, props in coal mines, or for fire-wood. Efforts have been made upon two occasions to collect sumac growing in this vicinity and prepare the same for market by thrashing with flails, but they were unsuccessful on account of the low price received. Where the timber has been cut and the land has not been since cleared, a second growth is springing up from the old stumps and is growing very fast. There have been instances in which timber was cut a second time within twenty-five years, the timber cut being suitable for railroad ties, fence posts and rails. In many sections in the mountains a second growth of timber is prevented by fires, either set by locomotives, or by parties desiring to prepare the land for pasturage.

164. The timber is generally used for railroad ties and props in coal mines.

165. The timber is used.

166. The timber cut for bark is all used for railroad ties, rails, and cord-wood. Sumac was formerly collected and sent to the large cities, but none is collected at present.

167. Nearly all of the timber is left upon the ground to decay. Nothing has been done in this vicinity to increase the growth of bark timber.

168. From thirty to forty cords of wood is wasted annually. Sumac grows abundantly but is not collected.

169. About one-half of the timber cut for bark is used. Fifteen hundred cords of bark were shipped to the Pittsburgh market from this vicinity during the present season, 1881.

170. The timber is left upon the ground to decay. About 200 trees are wasted annually.

172. All of the timber is used for lumber.

174. All of the timber is utilized.

175. The timber cut for bark is all used.

176. The timber is generally used.

177. The timber is all used.

178. The timber is generally used. "In view of the increasing demand for leather, which is the result of a large immigration, must or should, in my judgment, suggest to our government some plan to renew the hemlock forests that have been sacrificed for the trade; and in view of the fact that millions of acres of land in the States are now

the tanning business will do more to build up and economize this industry than anything else. Bark is of a good quality, water power abundant, timber land cheap, and in our mountains the chestnut oak and hemlock abound, and with good railroad facilities hides can be made into leather as well and at as little cost as in any part of the Union."

8. The timber is generally used for stove wood.

TENNESSEE.

2. The timber is generally used.

3. About one-half of the timber is left upon the ground to decay.

4. The trees are usually left upon the ground to decay.

5. Sumac is abundant in this vicinity; very little of it is collected. There are thousands of acres of prime chestnut-oak timber growing in Middle and Eastern Tennessee, which will remain until the further extension of railroads will make it available. At the present time the gradual increase in the branches of the railroads in Middle Tennessee has about kept pace with the demand for bark, while in the eastern division the recent opening of longer lines has brought the bark of that section into the market in much larger quantities.

6. About 400 cords of wood are allowed to rot upon the ground. Sumac grows abundantly, and in former years it was collected in large quantities and shipped.

7. The timber is generally used for rails and wood. There is but little sumac growing in this locality, and none of it is collected. Very little tanning is done here.

8. The timber is, as a rule, left upon the ground to decay.

9. About 4,000 trees wasted annually.

10. Three hundred trees are left upon the ground annually.

11. Timber is generally left upon the ground; 50 trees wasted annually.

12. The timber is generally left to decay or burned in log heaps. In the manner in which bark is peeled here it requires the bark of eight trees (each of which yields a cord of wood) to furnish a cord. The waste of timber in 1880 amounted to at least 275 cords, and in 1881 to 400 cords.

13. About 10,000 trees are wasted annually. The mountains in this vicinity are very heavily timbered. Large quantities of sumac are growing, but there is none collected.

14. The chestnut oak in Eastern Tennessee is taken from steep mountain ridges. The yield is but few trees per acre, and it does not pay to get out the timber. About one-half of the timber cut for the bark is left upon the ground to decay.

15. All of the timber is used for cord-wood and lumber. The growth of timber is equal to the demand. "I have adopted the plan of cutting out the old and dying trees, and allowing the young and thrifty ones to grow."

16. From eight to ten trees to the acre are wasted. Black oak is very abundant in this vicinity. The supply of chestnut oak is quite limited, and will not last more than two or three years longer.

17. One hundred and fifty trees are wasted annually. Much of the timber is cut for the purpose of clearing the land, without reference to the bark as an article of commerce. Sumac grows abundantly, but is not collected.

18. The timber is used for rails, lumber, and fuel.

19. About 170 cords of wood are annually wasted. Sumac is very abundant. Very little of it is collected for home use, and none of it is shipped. The "Stars Mountain," five miles east of this place, produces large quantities of chestnut oak, and from that point on across the line into North Carolina it grows abundantly in the mountains. The supply used by us is furnished by the foot-hills of these mountains.

20. The timber cut near the railroad is used for fuel. The remainder is left to decay. Sumac is abundant, but is not collected. There is but little tanning done in Tennessee. The bark is weak, and more is required than if chestnut oak or hemlock were used. White-oak timber is abundant, but is too valuable to cut for the bark.

21. The timber is generally used for lumber. About 3,000 cords of bark have been shipped from this vicinity to Louisville, Ky., during the present year.

22. Timber is used.

23. One-fourth of the timber is used.

24. The timber is wasted. From 4,000 to 5,000 trees are left upon the ground annually to decay.

25. About one-half of the timber is burned upon the ground.

26. From 300 to 600 trees are left upon the ground annually.

27. The chestnut oak is generally left upon the ground to decay.

28. There are 300 trees left upon the ground annually. Black sumac grows abundantly upon cleared land. No use is made of it.

TEXAS.

1. The timber is generally used for railroad ties and fire-wood. Sumac is used here, but none is shipped. The supply of bark is inexhaustible. The forests are large, and the condition of the soil is such that it cannot well be drained and cultivated.

2. The timber is all used. Care is taken to preserve the live-oak timber; the tops alone are cut and peeled, and the trees are allowed to sprout again. This process can be repeated at intervals of a few years each.

3. About one-half of the timber is allowed to decay upon the ground. The sweet gum and ash grow in this vicinity, and are excellent for tanning. Ash, by cold leaching, reaches 54° of strength, sweet gum, 42°. Both produce a color resembling hemlock. Sweet gum is very abundant. Bark timber is plenty, and there are but few tanneries in Eastern Texas. The bark is not utilized for want of capital.

5. The timber is generally left upon the ground to decay. The bois-de-arc grows abundantly in this section, and furnishes an excellent tanning material. A large per cent. of tannin is contained both in the wood and in the fruit. There is a weed growing here called "brown weed," which is sometimes used for tanning purposes.

6. Most of the timber cut for the bark is left upon the ground to decay.

UTAH.

1-3. The timber is used for lumber and fire-wood.

VERMONT.

1. About one-fourth of the timber is left upon the ground to decay. Bark is shipped to Boston. Sumac grows in abundance, but is not collected.

2. The timber is all used for lumber.

4-10. The timber is all used. Sumac is not collected.

11. Very little tanning is done here. The timber is all manufactured into lumber. Bark is scarce and expensive. The supply used is obtained within a radius of 20 miles, and is diminishing every year. The sumac in this section is of limited growth. It is not abundant, and is not used for tanning purposes.

12. The timber is all used.

13. The trees are usually cut into lumber or wood. Very little sumac grows, and it is not collected. From 75 to 100 cords of hemlock is shipped to Massachusetts annually from this vicinity.

14-17. The timber is all used.

VIRGINIA.

1. The timber is all used.

2. The timber is generally used. About 1,000,000 pounds of sumac is collected and shipped to Richmond from this section annually.

4. The timber is generally manufactured into lumber. Sumac is collected and used. Some of it is shipped to other points.

5. The trees are all used for fire-wood. Large quantities of sumac are collected.

6. All of the timber is used. Sumac is collected and shipped to Alexandria and Baltimore.

7. The trees are generally used.

8. One hundred trees wasted annually.

9. The timber is used for rails and lumber. Sumac is collected, prepared, and shipped to foreign countries.

10. Timber is used for staves. Sumac is collected and shipped to Richmond, Va.

11. The timber is generally used. Sumac is abundant, but is not collected.

12. One-half of the trees are left upon the ground to decay. This section is densely timbered (the varieties being oak, poplar, chestnut, and hickory), but has no railroad facilities.

13, 14, 15. The timber is used.

16. The trees are generally left upon the ground. Probably 300 cords of wood are annually wasted. Small quantities of sumac are collected and shipped to Winchester, Va. Our bark supply is obtained from what is known as the Massimatten Mountain. Bark is abundant, though difficult of access. Large quantities are shipped out of the State.

17. About twenty cords of wood are wasted annually.

18. Most of the trees are left upon the ground to decay. Sumac is collected and shipped to Winchester. "The lands upon which the chestnut oak grows in Virginia are mountain lands, too steep and rocky for any purpose of agriculture, other than vineyarding, orcharding, or perhaps with some of it, grazing, and are valuable only for bark, wood for smelting the iron ores abundant here, and of fine quality and high per cent. In this locality the furnace men utilize large quantities of the timber cut by the tanner. Bark forests, when cut down, do not give place to other kinds of timber, as is so frequently the case with other kinds of timber lands, but rapidly and thriftily shoots up a new growth to the exclusion of the other timber, and, in time, renews the bark supply."

21. The timber is used for railroad ties and wood. About 1,200 to 1,500 tons of sumac are ground here and shipped to Baltimore, Philadelphia, New York, and Boston. "I also grind from 600 to 1,000 tons of black oak bark, which is mostly shipped to Europe."

22. About 15,000 trees are wasted annually.

23. Sumac is collected. From 500 to 600 tons of sumac are shipped annually to Philadelphia and Wilmington. Three thousand cords of bark are shipped from this country annually, and the supply is being rapidly exhausted.

WASHINGTON TERRITORY.

1. The timber is seldom used; 350,000 feet of lumber is wasted annually. "Have been engaged in tanning for twenty-five years, using fir bark, which is abundant, and can be purchased at \$4 per cord. Finding it unprofitable, as the leather was open and very light, but tough and strong, I have used alder, and am now using hemlock entirely, finding it most profitable. Our hemlock differs materially from that in the Eastern States, being as fair as chestnut oak, quite thin, with scarcely any rot on it, requiring an average of about four trees to the cord, which are peeled a length of 100 feet or more. A tree having a diameter of 4 feet or more at the stump, and peeled a distance of 150 feet, seldom furnishes a cord of bark. This bark makes a very good leather for skirting, and I consider it preferable to the eastern hemlock."

WEST VIRGINIA.

1. About 380 trees are annually left upon the ground to decay. Sumac is abundant, but is not collected. Timber is cut in this section in order to clear the land and furnish grazing for cattle, and much of the timber is burned upon the ground.

2. Tanning is not a profitable business here at present on account of the high price of bark.

3. About 400 trees are annually left upon the ground to decay.

4. The trees are usually left upon the ground to decay, though recently a portion of the timber has been used for railroad ties and fencing. Bark of the best quality is abundant in this locality. "I find that chestnut oak gives the most profit and produces a very fine leather."

6. One-fourth to one-third of the timber is wasted, about 5 cords of wood to one cord of bark. Extract is used to facilitate the tanning.

7. Timber is generally used for coopers' materials and fence rails.

8. The timber is used for rails, and railroad ties. From 300 to 500 cords of bark are shipped annually from this point.

9. There are 5,000 trees left upon the ground and allowed to decay annually.

10. Three hundred and twenty-five trees are left upon the ground annually to decay.

11. The timber is generally used for fence rails and railroad ties. The practice of deadening trees by girdling them was formerly practiced here, but is growing into disfavor. There is probably one-third as many white oak trees in this vicinity as chestnut oak. None of the white oak bark is saved, although it contains one-half as much tannin as the chestnut oak. Black oak also grows here, but cannot be used for tanning sole leather, as it causes a bloom on the grain of the leather, which depreciates its value.

12. About one-half of the timber is used for fence rails, staves, &c. A law should be enacted prohibiting the useless waste of chestnut oak bark.

13. About 30 trees are wasted annually. Bark should be used the season in which it is cut, as it loses its tanning qualities by being kept.

14. One hundred and twenty-five to 140 trees cut, which are principally left upon the ground to decay. The supply of chestnut oak bark is rapidly diminishing. At least 2,500 cords were shipped to Wheeling during the year 1881. Spruce pine is, however, abundant here, and produces excellent leather when used with oak bark. This establishment has been in operation for sixty years, and during thirty years of that time has consumed 125 cords of bark annually. Forest fires, which are set for the purpose of affording grazing for cattle, destroy much timber.

15. The timber is generally wasted; from 600 to 800 trees are left upon the ground to decay annually. Both oak and hemlock timber are abundant in this locality. Very little hemlock has as yet been used for tanning purposes.

15. Chestnut oak is abundant, but is difficult of access.

17. The trees cut for bark are all left upon the ground.

18. One hundred trees are either left upon the ground to decay or burned annually. Large quantities of chestnut oak bark are annually destroyed by deadening the trees.

19. The timber is generally used. Chestnut oak is abundant in the hills of this region, and is only peeled as the timber is needed for use.

20. Most of the timber is burned upon the ground.

21. The trees are generally left upon the ground to decay. Bark timber is abundant, but there are no means of conveyance to market.

WISCONSIN.

1, 2. The timber is generally used.

3. Bark is obtained from Michigan.

4. The timber cut for the bark is generally used.

5. About 1,000 trees wasted annually.

6. The timber is used for lumber and building purposes. The supply of bark is becoming scarce, and some means should be adopted for continuing the supply.

7. The timber is all used.

8. About one-half of the timber cut for the bark is used.

9. Most of the trees are left upon the ground to decay. Much bark is wasted by careless handling, and very little is done by tanners in order to economize in the use of bark. The government should retain possession of timber land, now owned by it, in order to provide for the future wants of the public.

10. A portion of the timber is burned upon the ground.

11. Forty thousand trees are wasted annually; most of the bark used is shipped by lake from Michigan. This establishment has been in operation thirty years, and during that period has consumed at least 210,000 cords of bark, to furnish which 840,000 trees have been cut, and allowed to rot upon the ground.

12. Bark is shipped from Northern Wisconsin and Michigan, and the timber is generally left upon the ground to decay. Oak and hemlock trees should be planted.

15. It is estimated that the tanneries around Lake Michigan, from Two Rivers to Whitehall, use 120,000 cords of bark annually. No methods for economizing in the use of materials have been employed. "Tanners around Lake Michigan seem to be able to compete with those in New York State and Pennsylvania, although bark costs them less by one-half than here, and the tanneries are being built and enlarged in the large cities (Chicago and Milwaukee), and abandoned in the country. The bark is brought to the hides, the labor, and the demand for leather. This is for the business around Lake Michigan, contrary to New York State and Pennsylvania, where the tanneries are mostly located in the hemlock forests."

16. The timber is generally used.

19. A portion of the timber is left upon the ground to decay. Bark is becoming scarce, and the supply is rapidly diminishing.

20. "There is no hemlock growing in this vicinity, and we receive our supplies from Northern Wisconsin and Michigan. We understand a great many of the trees are left upon the ground to decay, and no method of economizing or enlarging the production has ever come to our notice."

22. There is no bark peeled within 60 miles of this place. The timber cut for the bark is generally left upon the ground to decay.

VII.—FOREST FIRES.

1.—PRELIMINARY CONSIDERATIONS.

(a.) Importance of the subject.

The importance of the injuries that are done to forests by running fires has led us to give particular attention to this subject, as directly relating to the maintenance of forest products within the United States. For the reasons stated under the following pages, we have collected, and in most instances condensed, the statutes of the different States and Territories relating to this subject, and after these the laws and regulations adopted in other countries, some of which might readily be adopted with great advantage in our own country. The whole series of these laws and regulations will afford ready assistance in the preparation of new laws upon the subject, or in the amendment of existing statutes.

These laws are followed by abstracts from replies of correspondents to local inquiries, and after these are presented various plans and suggestions that are regarded as valuable in measures for the prevention and control of these fires—the question of forest-fire insurance, as it stands at the present time in Europe, and such historical accounts as illustrate the terrible extent of these injuries, as they sometimes happen in hot and excessively dry seasons. The possibility of their occurrence presents the strongest possible motive for precautions, by which alone they may be prevented at times when the conditions threaten the greatest danger.

(b.) Advantages to be gained by following the Subject historically.

In following the successive steps of legislation upon a given subject, it may generally be expected that the earlier statutes embody the theoretical ideas of their authors, and the later ones, the modifications that these undergo when tested by experience. In a series of general statutes, therefore, the differences introduced by way of amendment, may be regarded as an evidence of an error to be avoided, a fault corrected, or an omission supplied. In this sense these earlier statutes, although obsolete, still have their value as showing the growth of ideas, and when compared with those of later date, they serve the useful purpose of indicating such provisions of law as have been tried and found wanting, and that therefore should be avoided. These considerations have accordingly led us to present, in the study of forest fires, as given in this report, so far as it could be done, the full history of legislation in the several States and Territories upon this subject.

(c.) Differences due to Soil, Climate, and other Conditions.

There can be no doubt but that differences of soil, of climate, and of circumstances, demand in some degree a modification of statutes to meet the wants presented in these variable conditions, and that therefore a universal law for the prevention of forest fires could scarcely be framed in such a manner as to be equally applicable to every section of the country. As a leading object in presenting this subject has been to offer suggestions that have been thoughtfully devised, and carefully modified from experience, we have thought that this could be done in no way so effectually as by the statutes themselves. The information upon which they were founded has seldom been preserved, and the discussions that may have been had upon these projects, have for the most part been forgotten or lost. The laws themselves, however, unquestionably embody in every instance the views of those who enacted them, or at least the major part, and it may be fairly presumed that the earliest statute in the series of each State, not less than its subsequent amendments, represents the sum of experience and observation on the part of those who framed it.

(d.) The dangers are always greater in new Settlements.

It is observed everywhere, that in the first beginnings of a settlement, whether in a forest region or upon the prairies and the plains, the dangers from ruining fires are greatest, and that they gradually diminish as the region becomes thickly settled and well cultivated. This partly results from the diminution of loose and inflammable materials, and partly to the increasing vigilance of the inhabitants, and the habitual care against accidents by those who have property to protect. The amendments to statutes may therefore in some cases be simply an indication of this change of conditions, and allowance should be made for these changes in estimating the propriety of the measures that such statutes provide.

(e.) The improvident habits of Pioneers.

It is further to be remembered, that the earliest of the pioneers in a new settlement, are often those who do not make permanent improvements, but under a restless desire for change they seek a new field of

enterprise long before the society around them has become permanently settled and well established. This unstable and transient class, the first beginners, are generally persons of slender resources, and have little to lose. They are accustomed to regard the world around them as open for their use, and in matters of pasturage for their stock, as well as forest products for their own supply, and often for such little industries as they can undertake upon a small capital or by their own labor, they often appropriate wherever it is most convenient. It is from this class of our population that we have the most to fear in the way of forest fires. Habitually careless and improvident, they do not hesitate, where there is a motive and an opportunity, to apply fires to lands not their own, for the purpose of improving and extending the range for their cattle, or to clear lands for cultivation, and sometimes to destroy the evidences of their own trespass and depredations.

(f.) *The Difficulties arising from Self Interest.*

These fires present the greatest difficulties for prevention or punishment, and often for control, on account of the facility with which they may be started, the abundance of combustible material in a new country, and the fewness of willing hands to aid in the efforts made for extinction. In our reports from correspondents, it will be seen that in some instances whole communities regard these fires with satisfaction, providing that they escape personal damage, and that with this general community of interest, the enforcement of laws, however salutary or much needed they may be, can scarcely be expected and but seldom secured. These considerations should of course be duly weighed in adapting a statute to the conditions of a given region, for it is undoubtedly preferable to adopt a measure that can be enforced and sustained, even although manifestly short of meeting every requirement that is desirable, rather than one, however perfect in its provisions, which cannot be sustained.

2. SUMMARY OF LEGISLATION TENDING TO THE PREVENTION OF FOREST FIRES WITHIN THE UNITED STATES.

(1.) ALABAMA.

By an act passed February 10, 1803, while this State was a part of Mississippi Territory, entitled "An act to prevent unlawful hunting, and for other purposes," a fine equal to double the damages, was imposed, for injuries done to stock by fires, besides severe corporeal punishment upon slaves convicted of thus hunting, and a fine of \$10 to the master, for each offense.

An act approved December 12, 1822, entitled "An act to suppress the evil and pernicious practice of fire-hunting," repealed the former act, and substituted a fine of \$50, half to the informer, and half to the county. It applied only to the practice of deer hunting by night, with gun and fire.

By "An act to prevent the burning of the woods at improper seasons of the year," passed in 1852,¹ It was forbidden, without the owner's consent, to willfully set fires with the intent to burn a forest, woods, or woodlands, upon any lands of another, excepting in the months of February and March, under a penalty of \$10 to \$200. If such fires were communicated negligently, the fines were to be of half the above amount.

¹ Laws of Alabama, 1852, chap. 23, page 52.

The owner might bring a further action for damages from fires set at any other season of the year.

The firing of any pine forest, with willful intention to burn, injure, or destroy it, where it had been cut, boxed, and used for the production of turpentine, was, by an act passed in 1856,¹ made an indictable offense, and punishable by imprisonment in the State penitentiary not less than two months nor more than five years, or in the county jail not more than twelve months, and a fine of not less than \$100. If the offense had been done by a slave, he was to be branded or whipped, or both, at the discretion of the jury, but the whipping was not to exceed one hundred lashes for the same offense.

If such fires were set by a white or free colored person through carelessness or inattention, the offense was to be deemed a misdemeanor, and upon conviction in the circuit court of the district, where the pinery was located, he might be fined not less than \$50, nor more than \$200.

A law passed in 1868,² and limited to Coosa County, prohibited any person from coming into the county for the purpose of camp-hunting or fishing, burning wood, or doing other injury to property, under penalty of not less than five times the value of the property so injured or destroyed, or imprisonment in the county jail not more than thirty days. If in such camping, fires were set to the woods, the parties became liable for all damages.

A law applicable to the counties of Jefferson and Tuscaloosa only, was passed in 1873,³ prohibiting the burning of any woods within five miles of the coaling grounds of any iron company making iron, or preparing to make iron, without the consent of such companies first obtained. A fine not exceeding \$5,000, or imprisonment not exceeding ninety days in the county jail, might be ordered upon conviction, by the court trying the same, besides a fee of \$20 to the solicitor, to be taxed upon the defendant, and collected as in other cases of misdemeanors. This act was not to apply to teamsters.

A law limited to Washington County, passed in 1875,⁴ the setting of fires to woodlands that cause injuries beyond the owner's premises, might be punished by hard labor for not less than three nor more than six months. This act was limited to three years, but was repealed January 23, 1877, and instead thereof an amendment was made to the revised code, under which any person who willfully sets fire to the woods, or forest, on inclosed lands of another, or who willfully causes fire to be communicated to such premises, except in February and March, becomes liable to a fine of not less than \$10, nor more than \$200, the same being made to apply to the County of Washington.

(2.) ARIZONA.

The Compiled Laws of this Territory contain the following provision against the firing of woods:⁵

SEC. 144. "If any person or persons shall wilfully and intentionally or negligently and carelessly set on fire, or cause or procure to be set on fire, any wood, prairies,

¹ "An act to prevent the burning of forests worked for turpentine." *Laws of Alabama*, 1855-6, chap. 30, page 19.

² "An act to prevent trespass by camp-hunters in Coosa County in the State of Alabama." *Private laws of Alabama*, 1868, chap. 38, page 403.

³ "An act to prohibit the burning of any woods within five miles of the coaling grounds of any iron company within the limits of the counties of Jefferson and Tuscaloosa." Approved March 28, 1873.

⁴ "An act to prevent woods burning in Washington County." *Laws of Alabama* 1874-5, chap. 343, page 507.

⁵ *Compiled laws of Arizona*, 1864-71, page 95, sec. 144.

grass or other lands or grounds in this Territory, every person so offending shall, on conviction before any court of competent jurisdiction, be fined in any sum not less than two hundred nor more than one thousand dollars, or be imprisoned in the county jail not less than ten days nor more than six months, or by both such fine and imprisonment, in the discretion of the jury trying the case; *provided*, that this section shall not extend to any person or persons who shall set on fire any wood, prairies, grass or other lands adjoining their own farm, house, plantation or inclosure, for the necessary preservation thereof from accident or injury by fire, by giving to his, her, or their neighbors reasonable notice of such intention."

(3.) ARKANSAS.

AN ACT to prevent the firing of Woods, Marshes or Praries, etc.¹—(Approved February 3, 1875.)

Be it enacted by the general assembly of the State of Arkansas :

SECTION 1. That if any person shall wilfully set on fire any woods, marshes, or prairies, so as thereby to occasion any damage to any other person, such person shall pay a sum not less than twenty-five nor more than three hundred dollars, one-fourth thereof for the use of the person suing for the same, and the other three-fourths to the use of the public school fund of the county in which the offense is committed; in default of payment of such fine, he or she be imprisoned in the county jail not less than ten nor more than sixty days.

SEC. 2. That if any person shall wilfully set on fire any woods, marshes, or praries not his own, such person shall be fined in any sum not exceeding one hundred, or be imprisoned in the county jail not less than ten nor more than thirty days.

SEC. 3. That if any person shall wilfully set on fire any woods, marshes, or praries, whether his own or not, so as thereby to occasion any damage to any other person, such person shall make satisfaction in double damages to the party injured, to be recovered by civil action.

SEC. 4. When an offense shall be committed against this act by a hireling, with the consent or by the command of his employer, such employer shall be liable in the same manner and to the same extent as if the act had been committed by himself.

SEC. 5. *Be it further enacted*, That if any person shall set on fire any grass or other combustible material within his inclosures, so as to damage any other person, such person shall make satisfaction in single damages to the party injured, to be recovered by civil action, in any court having jurisdiction of the amount sued for; but if any such person shall, before setting on fire, notify those persons whose farms are joining said place which he proposes to burn that he is going to fire such grass or other combustible matter, and shall use all due caution to prevent such fire from getting out, to the injury of any other person, he shall not be liable to pay damages as provided in this section.

SEC. 6. *Be it further enacted*, That if two or more persons shall wish to burn off any woods, or marshes, or praries for the benefit of such neighborhood, they shall give notice of such intention to those concerned in the immediate vicinity at least one day before such burning, and if a majority of those living contiguous thereto shall consent to the same, and said persons shall use all due caution to prevent damage thereby, such persons shall not be liable to the penalty in the foregoing sections of this act.

SEC. 7. That this act take effect and be in force from and after its passage.

(4.) CALIFORNIA.

AN ACT to prevent the Destruction of Forests by Fire on Public Lands,² (Approved February 13, 1872.)

SECTION. 1. Any person or persons who shall wilfully and deliberately set fire to any wooded country or forest belonging to this State, or the United States, within this State, or to any place from which fire shall be communicated to any such wooded country or forest, or who shall accidentally set fire to any such wooded country or forest, or to any place from which fire shall be communicated to any such wooded country or forest, and shall not extinguish the same, or use every effort to that end, or who shall build any fire, for lawful purpose or otherwise, in or near any such wooded country or forest, and through carelessness or neglect shall permit such fire to extend to and burn through such wooded country or forest, shall be deemed guilty of a misdemeanor, and on conviction before a court of competent jurisdiction, shall be punishable by fine not exceeding one thousand dollars, or imprisonment not exceeding one year, or by both such fine and imprisonment; *provided*, that nothing herein contained shall apply to any person who in good faith shall set a back fire to prevent the extension of a fire

¹ *Laws of Arkansas, 1874-'75*, page 128.

² *Laws of California, 1871-'72*, chap. 102, page 96.

already burning. All fines collected under this act shall be paid into the county treasury for the benefit of the common school fund of the county in which they are collected.

(5.) COLORADO.

By an act passed in 1861,¹ the following provision is made to prevent fires from being set upon prairies:

SECTION 129. If any person wilfully set fire to the grass upon any prairie, for the purpose of destroying the same, or to the trees, grass, leaves or underbrush, in any forest or timber, so as to destroy or kill the trees in said forest, or any part of them, such offender shall be fined, in any sum not less than twenty nor more than two hundred dollars, or shall be imprisoned in the county jail not exceeding six months, or may be both fined and imprisoned.

SEC. 130. If any person carelessly set fire to the grass upon any prairie, so as to destroy the same, or leave a fire burning upon or near any prairie, which shall be communicated by the wind to the same, and destroy the grass thereon; or if any person carelessly set fire to trees, grass, leaves, or underbrush in any forest or timber so as to destroy or kill the trees in said forest, or any part of them, or leave a fire burning in or near any forest or timber which shall be communicated by the wind to the same, and destroy or kill any of the trees thereof, such offender shall be fined in any sum not exceeding twenty-five dollars.

SEC. 131. Nothing in this act shall be construed to apply to any person who may, in the months of March and April, set fire to the grass upon his own land, or upon public lands unclaimed or unoccupied, which fire he shall keep within proper control, and prevent it from doing injury or damage to the property of others.

SEC. 132. In case any person shall set fire to any prairie, timber, or forest, he shall be liable to the parties (if any), who are damaged thereby, to the whole amount of said damage and costs, to be recovered by suit at law.

By an amendment passed in 1879,² railroad companies were required to cause a strip of land not less than 6 feet wide, to be plowed every year, between the 15th day of July and the 1st of October, upon each side of the line of road, so as effectually to destroy and cover up the vegetation thereon, and be sufficient to prevent the spread of fires. The outer line of these strips was to be upon the line of the right of way, or, if upon lands owned by the company, 100 feet from the centre of the road. This was not to be required within the limits of any town or city, nor along the line of a railroad running through the mountains, where plowing would be impracticable. The practice might also be omitted in counties where the board of commissioners should certify their opinion that it was not necessary, either on the whole of the line within the county or in any particular part.

(6.) CONNECTICUT.

[From Revised Statutes: Civil actions: Of trespass. Edition of 1849, p. 128.]

SEC. 277. Every person who shall set fire on any land, that shall run upon the land of any other person, shall pay to the owner all the damage done by such fire, to be recovered in an action of trespass. (1836.)

[*Ib.* Civil actions: Of evidence: p. 84.]

SEC. 135. In all actions against any person or persons, or against any incorporated company, for the recovery of damages on account of any injury to any property, whether real or personal, occasioned by fire communicated by any locomotive engine while upon or passing along any railroad in this State, the fact that such fire was so communicated, shall be taken as full *prima facie* evidence, to charge with negligence the corporation, or person or persons who shall, at the time of such injury by fire, be in the use and occupation of such railroad, either as owners, lessees, or mortgagees, and also those who shall, at such time, have the care and management of such engine, unless such person, persons, or corporation shall show that no negligence was, at such time, justly chargeable to them, or to those in their employment. (1840.)

(7.) DAKOTA.

AN ACT to prevent the Firing of Woods, Marshes and Prairies.³ (Approved January 5, 1869.)

Be it enacted, &c.

SECTION 1. If any person or persons shall willfully set on fire or cause to be set on fire any woods, marshes or prairies, with intention to damage or injure the property of

¹ *Laws of Colorado*, 1861, page 317, sec. 129.

² *Laws of Colorado*, 1879, p. 73.

³ *Laws of Dakota* 1868-'69, p. 231, chap. XVIII.

another person, such person or persons, so offending, shall upon conviction thereof be fined in a sum not more than five hundred, nor less than fifty dollars, and imprisoned in the county jail not more than six months, nor less than thirty days or both, at the discretion of the court, and shall be liable for all damages done by such fire.

SEC. 2. If any person or persons shall negligently or carelessly set on fire, or cause to be set on fire, any woods, marshes, or prairies, the person or persons so offending, shall upon conviction be fined in a sum not more than one hundred nor less than ten dollars upon conviction thereof, and shall be liable to injured parties for all damage occasioned by any fire set or caused as aforesaid, to be recovered by civil action.

SEC. 3. That any person or persons setting on fire or causing to be set on fire, any woods, marshes or prairies, or lands owned or occupied by him, her or themselves, for the purpose of securing his, her, or their own property, from damage or destruction by prairie fire, shall be held liable for all damage occasioned thereby: *Provided*, That nothing in this act shall be so construed as to prevent any person or persons from firing against fire when his, her, or their own property is in imminent danger of damage by the near approach of prairie fire.

SEC. 4. It shall be lawful for any person or persons to set on fire or cause to be set on fire any marshes or prairies, owned or occupied by him, her or themselves, during the months of March, April and May: *Provided*, That the person or persons desiring to set such fire, shall give at least twenty-four hours' notice to all persons occupying lands within one mile of the place where such fire is to be set.

SEC. 5. No property, real or personal, shall be exempt from seizure and sale, on execution issued to satisfy any judgment obtained under the provisions of this act.

SEC. 6. All acts and parts of acts in conflict with the provisions of this act are hereby repealed.

(8.) DELAWARE.

By a statute dating from the Colonial period,¹ it was provided that any person firing or causing to be set on fire any woodlands or marshes, before the 10th day of March, or after the 1st day of May, yearly, should, upon conviction before two justices of the peace, forfeit and pay a fine of not over £5, with costs, one half to the informer, and the remainder to the poor. He also became liable for the damages that might result from his act. In default of goods upon which these costs and penalties might be collected, the person convicted might be held to make good all damages by servitude. A negro or mulatto slave, upon conviction, might be publicly whipped, with any number of lashes not exceeding thirty-one.

This statute was afterwards modified, so as to apply to certain specified parts of Newcastle and Sussex only. Slaves might in addition to the personal punishment before provided, be imprisoned until the costs resulting from their prosecution had been paid by their owners.²

Under the revision of 1827, the fine might range from \$15 to \$200, and the statute was made to apply to the whole State. It was not to prevent the burning off of clearings, due precautions being taken to prevent mischief.³ The preceding statutes were at this time repealed, excepting as they might apply to prosecutions that had been already begun.

(9.) FLORIDA.

The statutes of this State, in respect to the "burning of timber, fences," etc., provide as follows:⁴

SEC. 5. Whoever wilfully and maliciously burns, or otherwise destroys or injures a pile or parcel of wood, boards, timber, or other lumber, or any fence, bars or gate, or a stack of grain, hay or other vegetable product, or any vegetable product severed from the soil and not stacked, or any standing trees, grain, grass, or other standing product of the soil, or the soil itself of another, shall be punished by imprisonment in the State penitentiary not exceeding five years, or by fine not exceeding five thousand dollars and imprisonment in the county jail not exceeding one year.

¹ *Laws of Delaware, from 1700 to 1797*, vol. i, chap. 80, p. 217.

² *Laws of Delaware*, vol. i, chap. 87, p. 232.

³ *Laws of Delaware, 1827*, chap. 11, p. 28.

⁴ *Laws of Florida, 1868*, chap. 4, p. 70, sec. 5.

(10.) GEORGIA.

Concerning the firing of woodlands, the laws of this State provide as follows:¹

SEC. 5. Any person who shall wilfully and maliciously set on fire, or cause to be set on fire, any woods, lands, or marshes within this State, so as thereby to occasion loss, damage, or injury to any other person, such person so offending shall, on conviction, be punished by imprisonment in the common jail for any time not exceeding six months, at the discretion of the court.

SEC. 6. If any person shall wilfully and maliciously set fire to any fences, or other inclosure, or cause or procure the same to be done, or shall take from such fence or inclosure any rail or rails, or other material of which the same is made or composed, for the purpose of using the same as fuel, such person so offending shall, on conviction, be punished by fine and imprisonment in the common jail of the county, at the discretion of the court.

By an act entitled—"An act to protect those engaged in the 'turpentine business,' and to prevent the setting on fire of woods or lands, except at certain times, and under certain circumstances, so far as the counties of Camden, Glynn, McIntosh, Scriven, Jefferson and Washington are concerned," approved December 29, 1847,² it was provided as follows:

The setting of fires in woods, lands, or marshes in these counties excepting between the 1st day of March and the 1st day of May, was forbidden, unless notice was given three days previous to the occupants of adjoining lands, and in all cases effectual care was to be taken to extinguish the fire, and prevent its reaching the said adjoining lands. White persons convicted of violating this law, might be fined a sum not exceeding \$50, and might be imprisoned for a time not exceeding three months. Slaves, or free colored persons might be punished by thirty-nine lashes, upon conviction before a justice of the peace.

(11.) ILLINOIS.

AN ACT regulating the Firing of Woods, Prairies, and other Lands.³ (Approved February 20, 1819.)

SECTION 1. *Be it enacted, &c.*, That whosoever shall, at any time, except as hereinafter excepted, wilfully or negligently set on fire, or cause to be set on fire, any woods, prairies, or other ground, whatsoever, within this state, and being thereof legally convicted by the oath or affirmation of one or more creditable witnesses, in any court having cognizance of the same, shall pay a fine not exceeding one hundred dollars, nor less than five dollars; the one half of which to be paid to the person prosecuting for the same; and the other half to the use of the county wherein the offence shall have been committed.

SEC. 2. *Be it further enacted*, When any person or persons so offending, shall thereby occasion any loss, damage or injury to any other person or persons, every person so offending shall be, and is hereby declared liable to make good all damages to the person or persons injured with costs of suit, in any court having cognizance of the same.

SEC. 3. *Be it further enacted*, When any servant or servants shall offend against the tenor of this law, and being duly convicted of the same, except his, her or their master or mistress shall pay the fine herein above provided, with damages and costs for said offence, then such servant or servants so offending shall be whipped not exceeding thirty-nine stripes, at the discretion of the court having cognizance of the same.

SEC. 4. *Be it further enacted*, That nothing in this act shall be so construed as to prevent any person or persons from setting on fire any rubbish, leaves or brush, on his, her, or their farms or plantations as often as occasion may require, if the same be done without damage to the property of any other person or persons: *Provided also*, That nothing in this act shall be so construed as to prevent any person or persons from setting on fire prairies or cleared land, between the first day of January and the first day of April, if the same be done without damage as aforesaid.

By an amendment approved February 14, 1823,⁴ it was permitted to set fires to woods or prairies immediately adjoining farms, between the 15th day of April and the 15th of October, and the provision in the fourth

¹Laws of Georgia, 1833, p. 194, sec. 5.

²Laws of Georgia, 1847, p. 296.

³Laws of Illinois, 1819, p. 384.

⁴Laws of Illinois, 1823, p. 140.

section of the former act, allowing fires to be set between the 1st of January and the 1st of October, was repealed.

AN ACT relating to Fires caused by Locomotives.¹

SECTION 1. *Be it enacted by the people of the State of Illinois represented in the general assembly*, That in all actions against any person or incorporated company, for the recovery of damages on account of any injury to any property, whether real or personal, occasioned by fire communicated by any locomotive engine while upon or passing along any railroad in this State, the fact that such fire was so communicated shall be taken as full *prima facie* evidence to charge with negligence the corporation or person or persons who shall, at the time of such injury by fire, be in the use and occupation of such railroad, either as owners, lessees, or mortgagees, and also those who shall at such time have the care and management of such engine, and it shall not, in any case, be considered as negligence on the part of the owner or occupant of the property injured, that he has used the same in the manner, or permitted the same to be used or remain in the condition it would have been used or remained, had no railroad passed through or near the property so injured, except in cases of injury to personal property, which shall be at the time upon the property occupied by such railroad. This act shall not apply to injuries already committed.

SEC. 2. This act shall take effect and be in force from and after its passage.

(12.) INDIANA.

AN ACT regulating the Firing of Woods, Prairies, and other Lands.² (Approved January 21, 1818.)

SECTION 1. *Be it enacted, &c.*, That whoever shall, at any time, except as hereinafter excepted, wilfully or negligently set on fire, or cause to be set on fire, any woods, prairies, or other grounds whatever within this State, and being thereof legally convicted, by oath or affirmation of one or more credible witnesses, in any court having cognizance of the same, shall pay a fine not exceeding one hundred dollars nor less than five dollars, to be applied for the use of county seminaries.

SEC. 2. When any persons so offending shall thereby occasion any loss, injury or damage, to any other person or persons, every person so offending shall be and is hereby declared liable to make good all damages to the person or persons injured, with costs of suit, in any court having cognizance of the same, and where any servant or servants shall offend against the tenor of this act, and being duly convicted of the same, his, her, or their master or mistress shall pay the fine herein above provided, with damages and costs of prosecution.

SEC. 3. Nothing in this act shall be so construed as to prevent any person or persons from setting on fire any rubbish, leaves or brush on his, her or their farms or plantations as often as occasion may require, if the same be done without any damage to the property of any other person or persons: *Provided also*, That nothing in this act shall be so construed as to prevent any person or persons from setting on fire prairies or cleared land between the first day of December and the first day of March, if the same be done without damage as aforesaid.

SEC. 4. This act shall be in force from and after its publication.

By a supplementary act approved January 10, 1823,³ the inhabitants of Fort Harrison Prairie were allowed to set fire to the grass on every Saturday in November.

In 1831 the law⁴ was further amended; any person wilfully and maliciously setting fire to woods or prairies other than his own, or permitting the fire to pass to the lands of others, became liable to a fine of not more than \$50, with costs of suit, besides liability to an action for damages that may result from such fire.

(13.) IOWA.

An act approved March 21, 1862,⁵ provided "that if any person set fire to and burn, or cause to be burned, any prairie or timber land, al-

¹Laws of 1869 (Chicago Legal News Ed.), p. 31.

²Laws of Indiana, 1818, chap. 75, page 361.

³Laws of Indiana, 1822, chap. 86, p. 439.

⁴Laws of Indiana, 1831, chap. 26, p. 198.

⁵"An act to prevent the spreading of fires on the prairies and in the timber, in certain seasons of the year." (Laws of Iowa, 1862, chap. 53, p. 57.)

lowing such fire to escape from his control, between the first day of September in any year, and the first day of May following, he shall be deemed guilty of a misdemeanor, and upon conviction thereof, shall be punished by imprisonment in the county jail not more than thirty days, or by fine not exceeding one hundred dollars. This has since been incorporated into section 3890 of the code."

Under the provisions of section 3889, of the code of 1873, it was provided that if any person should wilfully, or without using proper precautions, set fire to and burn, or cause to be burnt, any prairie or timber land, by which the property of another was injured or destroyed, he should be fined not exceeding \$500, or be imprisoned in the county jail not more than one year, or both, at the discretion of the court. This statute was modified March 16, 1878,¹ by extending it to include fires set in inclosed or cultivated fields, or in highways.

(14.) KANSAS.

Under "an act to prevent the firing of woods, marshes, and prairies," passed in 1855,² it was provided that if any person should wilfully set on fire any woods, marshes, or prairies, so as thereby to occasion any damage to any other person, he would be liable to a fine of not more than \$300, nor less than \$50. The simple firing of such places might be punished by a fine of \$100. The persons injured might recover satisfaction for the damages. The statute was not to extend to the case of persons setting fires on their own land, without intention to set on fire the adjacent woods, marshes, and prairies,³ nor was it to prevent firing against fires, so as to protect one's own property from being destroyed.

The penalties for wilfully setting on fire of woods, marshes, or prairies, so as to occasion damage to other persons, were in 1860,⁴ raised to a sum not exceeding \$500, or imprisonment in the county jail not more than six months, nor less than ten days, one-half of the fine going to the complainant, and the other half to the county common school fund. Upon neglect or refusal to pay the fine, the imprisonment might be extended one day for every dollar, until the fine was discharged. The person was to be further liable for all damages. This act was not to extend to persons setting on fire in the night time, on his own farm as often as occasion might require, if done without intention to set on fire the adjacent woods, marshes, or prairies not occupied by him, nor to prevent firing against fire, so as to protect property from being destroyed. It was made the duty of all sheriffs, justices of the peace, constables, and other sworn officers, to use all necessary means to convey information to the proper authorities of any violations of this act.

The section permitting the setting of fires at night on one's own premises without intending to set fire to adjacent premises was repealed February 26, 1863.⁵

By "an act in relation to fires," approved February 17, 1872,⁶ it was provided as follows:

Any person or persons who shall, between the first day of August and the fifteenth day of the following May, build or kindle or engage in building or kindling any fire

¹*Laws of Iowa*, 1878, chap. 55, p. 78.

²*Statutes of Kansas Territory*, p. 765.

³This provision was repealed February 17, 1857. (*Laws of Kansas*, 1857, p. 69.) The preceding statutes (omitting a clause relating to fires set by slaves, which had been embodied from the Missouri statutes in 1855) were confirmed by a new act having like terms and penalties, February 9, 1859. (*Laws of Kansas*, 1859, p. 421.)

⁴*Laws of Kansas*, 1860, p. 124.

⁵*Laws of Kansas*, 1863, p. 53.

⁶*Laws of Kansas*, 1872, p. 274.

upon lands not his or their own, or upon land not occupied by him or them as a tenant or tenants, and leave the same unextinguished, shall be deemed guilty of a misdemeanor, and shall be punished by a fine not exceeding fifty dollars, nor less than two dollars, or be imprisoned in the county jail for a period not more than one month nor less than ten days; or by both such fine and imprisonment.

(15.) KENTUCKY.

By an act approved December 21, 1831,¹ and applicable only to Harlan County, it was forbidden to set fire to the woods under a penalty of \$20 if a free person, and of whipping, not exceeding thirty-nine lashes, if a slave.

By another act, approved February 22, 1835,² and applicable to the counties of Perry, Clay, Whitley, Bullitt, Floyd, Pike, Morgan, and Knox, it was forbidden to set fires whereby the leaves and shrubbery should be burned, under penalty of \$40 to a free person, and whipping, not exceeding thirty-nine lashes, if a slave.

By an act approved February 7, 1840,³ it was forbidden to any person to set fire to woods in the counties of Clay, Rockcastle, Laurel, Greenup, Pulaski, Perry, Knox, Harlan, and Carter, with intent to burn the same, under penalty of from \$100 to \$300 upon conviction, upon indictment by a grand jury. The constables in these counties, upon their own knowledge or information of others, on learning that a forest fire had been started, were required to proceed forthwith to summon all the tithables in their districts, or as many of them as they might deem necessary, and go with and command the same, until the fire should be extinguished. The constables were allowed a dollar and a half a day for this service, to be paid out of the county levy, and they were liable to a fine of \$10 for each failure, upon prosecution by any person before a justice of the peace. Those neglecting to attend upon call by a constable were liable to the same fine, and the same proceedings were to be had as in cases where they failed to work upon the public highways. The provisions of this act were applied to the county of Grayson, as respected the burning of woods in the months of October, November, and December only.

This act was on the 29th of January, 1846, extended to include the county of Christian.⁴

(16.) LOUISIANA.

AN ACT to prohibit the Burning of the Woods in the Parish of Winn, in the State of Louisiana.⁵
(Approved March 17, 1859.)

SECTION 1. *Be it enacted by the Senate and House of Representatives of the State of Louisiana in General Assembly convened,* That from and after the passage of this act it shall not be lawful for any person or persons to set fire to or burn the woods in any part of the parish of Winn, or cause the same to be done, in the months of April, May, June, July, August, September, or October of each and every year, under penalty of being guilty of a high misdemeanor.

SEC. 2. *Be it further enacted, &c.,* That any person or persons offending against the provisions of the first section of this act shall, upon conviction by indictment or information before any court of competent jurisdiction, be fined in a sum not less than one hundred nor more than three hundred dollars, and in default of payment thereof shall be imprisoned not less than thirty nor more than sixty days.

SEC. 3. *Be it further enacted, &c.,* That one-half of said fine, when recovered, shall go to the informer, the other half to the parish of Winn.

SEC. 4. *Be it further enacted, &c.,* That this act shall take effect within sixty days after its passage.

¹ *Laws of Kentucky*, 1831, chap. 659, p. 97.

² *Ib.*, 1833, chap. 480, p. 679.

³ *Ib.*, 1839-40, chap. 246, p. 150.

⁴ *Laws of Kentucky*, 1845-46, chap. 107, p. 5.

⁵ *Laws of Louisiana*, 1859, No. 234, p. 184.

(17.) MAINE.

AN ACT to protect Forests and Timber Lands from Fires, and to punish the unlawful and careless Kindling of Fires. (Approved February 28, 1855.)¹

Be it enacted, &c.

SECTION 1. No person shall kindle a fire on land not his own, without the consent of the owner, under a penalty of ten dollars and costs, and to stand committed until the fine and costs are paid.

SEC. 2. If any person shall kindle a fire in any field, pasture or inclosure, forest or timber land, not his own, without the consent of the owner, and the same shall spread and do damage to any buildings, fences, crops, cord-wood, bark or other personal property, or to any wood or timber land, he shall, on conviction, be punished by a fine of not less than ten nor more than five hundred dollars, and costs, according to the aggravation of the offence, and shall stand committed till the fine and costs are paid.

SEC. 3. If any person shall maliciously, with intent to injure any other person, by himself, or any other person, kindle a fire on his own land, or on the land of another person, and by means of such fire the buildings, fences, crops or other personal property, or wood or timber lands of any other person shall be destroyed or injured, he shall, on conviction, be punished by a fine of not less than twenty dollars, nor more than one thousand dollars, or by imprisonment in the common jail or house of correction not less than three months nor more than twelve months, or in the State prison not less than one nor more than three years, according to the aggravation of the offence.

SEC. 4. If any person shall, for any lawful purpose, kindle a fire upon his own land, he shall do it at such time and in such manner, and shall take such care of it to prevent it from spreading and doing damage to other persons' property, as a prudent and careful man would do, and if he fail so to do, he shall be liable in an action on the case, to any person suffering damage thereby, to the full amount of such damage.

SEC. 5. Any person who shall enter upon the lands of another person, for the purpose of hunting or fishing, and shall, by the use of fire-arms, or other means, kindle any fire thereon, shall be liable to the penalties of the first, second, or third section of this act, as the case may be.

SEC. 6. Persons engaged in driving lumber, upon any waters or streams, may kindle fires when necessary for the purposes in which they are engaged, but shall be bound to use the utmost caution to prevent the same from spreading and doing damage; and if they fail so to do, they shall be subject to all the liabilities and penalties of this act, in the same manner as if the privilege granted by this section had not been allowed.

SEC. 7. The common law right to an action for damages done by fires is not taken away or diminished by this act, but it may be pursued notwithstanding the fines or penalties set forth in the first, second, and third sections of this act; but any person availing himself of the provisions of the fourth section shall be barred of his action at common law for the damage so sued for. And no action shall be brought at common law for kindling fires in the manner described in the sixth section; but if any such fire shall spread and do damage, the person who kindled the same, and any person present and concerned in driving such lumber, by whose act or neglect such fire is suffered to spread and do damage, shall be liable in an action on the case for the amount of damage thereby sustained.

SEC. 8. This act shall take effect and be in force from and after its approval by the governor.

The Revised Statutes of this State contain the following provisions concerning the injury done to property by fires set by locomotives:

When a building or other property is injured by fire communicated by a locomotive engine, the corporation using it is responsible for such injury, and it has an insurable interest in the property along the route for which it is responsible, and may procure insurance thereon.²

(18.) MARYLAND.

By an early statute in this State, it was forbidden to maliciously set on fire any woods, fences, marshes, lands, leaves, or rubbish thereon, within the counties of Baltimore, Anne Arundel, Frederick, Montgomery, Alleghany, Queen Anne, Harford, Cecil, or Prince George's, so as to occasion any loss, damage, or injury to other persons, under

¹*Laws of Maine*, 1855, chap. 132, p. 134.

²*Revised Statutes of Maine*, 1871, p. 454. (Title IV, chap. 51. "Railroads," sec. 32.)

penalty of a fine not exceeding \$100, one-half to the informer and the other half to the county, besides the costs; or, unable to pay this fine, by imprisonment not over six months. A slave thus convicted might be punished by whipping, not exceeding thirty-nine lashes, on the bare back, unless his owner chose to pay a fine not exceeding ten pounds. The owner of property injured or destroyed by such fires might recover its value from the party who caused it.¹

By an act passed March 29, 1838, entitled "An act to repair injuries done by fire from railroad engines,"² it was provided, that if any woods, fields, or other property, real or personal, be burned or injured by fire from engines, the company should pay the loss. Actions for damages under this act were to be tried at the first term of the court in which they are brought, if process be served on the defendant ten days before the court convenes, or, if not, then at the court next following. Service might be had upon any director, officer, attorney, agent, or servant of the defendant. Upon failure to appear, the court might after the second term, upon proof of service by the sheriff's return, or by affidavit, enter a judgment by default against the defendant, by a jury empannelled at bar, as in cases of writs of inquiry.

This act was modified in the following year, as follows:

AN ACT to repair Injuries done by Railroad Carriages and Engines upon the several Railroad Companies of this State.³ (Passed March 20, 1839.)

SECTION 1. *Be it enacted, &c.,* That the several railroad companies in this State shall be responsible for injuries hereafter resulting in death, or otherwise, inflicted upon any stock, or cattle, horses, sheep, hogs, &c., or by fire occasioned by their engines, or carriages, upon any of their roads, and the branches thereof, unless said company can prove to the satisfaction of the justice, magistrate's court, or other tribunal, before which said suit may be tried, that the injury complained of has been committed without any negligence on the part of said company or their agents; the damages claimed shall be sued for, and be recoverable by action of the owner or owners of said stock, or the person or persons, injured by fire as aforesaid, before a single justice of the peace, when the damages claimed shall not be over fifty dollars; before the magistrates' courts, when the damage shall not be over one hundred dollars, and before the county courts, when the damages shall be over one hundred dollars.

SEC. 2. *And be it enacted,* That the damages claimed under this act shall be sued for in the county where the injuries shall have been done, and that summons served upon the president or any one of the directors or conductors of any of said companies shall be considered proper service upon the corporations: *Provided,* That said service shall be made at least twenty days before the day of trial: *And provided,* That if said company shall not appear to answer at the time therein specified, on the return of two subpoenas, served as aforesaid, then the court shall proceed to enter up judgment against said corporation, as if said corporation had regularly appeared, provided said judgment shall not be rendered until affidavit shall be filed showing the name of the president, director, or conductor on whom said service was made, and the day of said service.

SEC. 3. *And be it enacted,* That any property belonging to said corporation shall be liable for the amount of all judgments rendered under this act: *Provided, however,* That nothing herein contained shall be construed to deprive either party of the right of appeal, as in all cases for like causes of complaint, or the right of removal of said causes to any other county court, as in other civil actions.

(19.) MASSACHUSETTS.

The early Colonial Records, both of Massachusetts and of Plymouth, contain regulations concerning damages from field and forest fires, that deserve notice in this connection.

In the former it was ordered July 26, 1631, as follows:

For the p'servagon of houses, hay, boards, timb'r, &c., it was ordered, that noe p'son whatsoever within the lynmitts of our pattent shall burne any ground any yeare till the

¹ *Marey's Laws of Maryland*, ii, chap. 39, p. 443.

² *Laws of Maryland*, 1837-'38, chap. 309.

³ *Laws of Maryland*, 1838-'39, chap. 244.

first of March, vnder such penalty as the court shall think meete to inflict; & if any p'son be desirous to burne any of his owne ground for corne before that time, hee shall make full satisfav'con for the damage it doeth, in case any be occacond thereby.

On the 5th of November, 1639, it was further enacted :

For the further p'venting of the damage which may come by the burning of ground at seasonable times, it is ordered, that whosoever shall kindle any fyre in other mens grounds, or in any comon grounds, for the gathering of akrons, or for taking of tobacco, or for any other occasion, except the party shall p'sently put out the same before it spreade, shall (besides full satisfaction for all damages, according to the former order) be fined 40 shs.; & if the party offending bee not able to pay the fine, or to satisfy the damages, hee or shee shal bee punished by whipping, or other corporall punishment (as the court, wch shall have cognisance of the cause, shall adjudge), p'vided, that this order shall not extend to persons that shall burne any ground for any needfull or fit occasion, in the first & second months; p'vided, also, that it shall bee lawfull for any man to kindle a fyre in his owne ground at any time of the year, so as no damage come thereby.¹

Under date of November 6, 1646, we find this further provision :

Whosoev'r shall kindle any fires in ye woods, before ye 10th day of ye first mo., or after ye last day of ye 2d mo., or on ye last day of the weeke, or Lord's day, shall pay all damages yt any p'son shall loose thereby, or halfe so much to ye comon treasury.²

In the Plymouth colony, regulations were established as early as September 4, 1638, as follows:

Whereas many have sustayned great damage by the indiscreet firing of the woods, It is by this p'nte order forbidden to any to set fyre on them except betweene the first day of the month of february and the middest of the month of Aprill. And that whosoever damage cometh to any by the breach of this order in firing the woods otherwise to be made good by the delinquent and whensoever any are justly occasioned to fyre the same they shall give warneing to the neighbours aboute them and If any p'son fire ye woods ye hath noe just cause so to do hee shall forfeite to ye countries vse or be whipt.³

By another regulation, dated October 20, 1646, it was ordered, that if any person should at any time set fire to the woods, and hath no just occasion so to do, he should be fined ten shillings to the government's use, or be whipped.⁴

The last regulation of the Plymouth colony is without date, and is as follows:

It is enacted by the Court that wheras many have sustained great damage by the Indiscreet firing of the woods, though Justly occasioned thervnto, that none shall fier the woods att any time but they shall give warning therof to the neighbours about them and the time of fiering of them to bee from the fifteenth of Febrewary to the latter end of Aprill; Also that if any p'son att any time shall fier any the woods and hath noe Just occasion soe to doe hee shal bee fined ten shillings to the vse of the government or bee whipt.⁵

By an act passed January 15, 1792-'93,⁶ after reciting that it had been found by experience "that the burning of woods does greatly impoverish the lands, preventing the growth of wood and destroys much fence, to the great detriment of the owners," it was provided that any person who should willingly set fire in any woods or land lying in common within the bounds of any town, without leave first had from the town or proprietors by a majority vote at a meeting for this purpose appointed, should be liable to a fine of forty shillings to the benefit of the person suing for the same, and a further action for damages. If done by a minor, the parent or master became liable, unless proved

¹ *Records of Massachusetts*, I, 1628, 1641, p. 90. *Ib.*, p. 281.

² *Records of Massachusetts*, II, 1642-1649, p. 180.

³ *Plymouth Colony Records*, XI, 1623-1682, p. 28.

⁴ *Ib.*, p. 54.

⁵ *Plymouth Colony Records*, XI, 1623-1682, p. 98: 179.

⁶ *Acts and Resolves of the Province of Massachusetts Bay*, 1742-1756, p. 40.

that the minor was employed by some other person, in which case the latter became liable.

Towns or proprietors might give order for setting fires and choose two or more persons for the service, appointing the times, and giving seasonable notice thereof in the towns where such lands laid, and to the selectmen of such adjacent towns as might be near the borders of their woods. Inasmuch as it is often impossible to prove facts in relation to the setting of fires, this law further enacted:

That upon process brought for setting fire as aforesaid, where proof cannot be made in the ordinary method and course of the law, if the plaintiff, complainant, or other credible person shall swear that fire has been kindled as is declared in the writ, and there does appear such circumstances as shall render it highly probable in the judgment of the court or justice, before whom the trial is, that the fire was kindled by the defendant, his child, or servant, or by some other child or servant under the age of fourteen years, directed or employed by the defendant for that purpose, then and in such case, unless the person charged (being of the age of fourteen years or upwards) will acquit himself upon oath administered to him by the justice before whom the trial is, the plaintiff shall recover against the defendant the penalty by this act imposed, and costs; but if the defendant shall acquit himself upon oath as aforesaid, judgment shall be entered for the defendant, his costs against the defendant.

This act was limited to three years, but in 1746 was continued till the end of 1752,¹ and in 1753,² when another statute was passed, embodying substantially the same provisions, and extending them to the woods belonging to individual owners. The penalties might be recovered by presentment of the grand jury, and on the trial of any presentment of an offence against this act, the same proof and evidence would be sufficient to convict the person presented, as was made sufficient in case of private suit for the penalty. The fines recovered were to be paid into the general treasury. Only one forfeiture could be recovered for the same offence, and when paid, this would be a bar to any after charge or prosecution. This act was limited to ten years,³ but was subsequently extended.

The colonial statutes upon the firing of woods were continued under the State government until March 10, 1797, when in a general law for the extinguishment of fires, and proceedings thereat, it was provided:

That if any person or persons shall wittingly or willingly set fire to any woods or lands lying in common, or to wood land or other land held in severalty, and not his own, within this commonwealth, without leave first had and obtained from the owners of the land, or those who have a right to give the same leave, excepting in cases in which it may become necessary to make back fires to stop the progress or subdue any fire that may be spreading, the person so offending shall forfeit and pay for each offense ten dollars, one moiety thereof to the use of him or them that shall inform and sue for the same, and shall be liable, in a special action in the case, to pay damages to all persons injured by such fire, including the injury which may be done by any necessary back fire, made for the purpose aforesaid, and in case any person under age, shall offend against this act, such penalty shall be recovered of the parent or master respectively, of such person under age, unless it shall appear such person under age was employed or directed by some person other than the parent or master, in which case the person so employing or directing shall be liable therefor, and the fines in this section mentioned may be recovered in an action of debt, with costs of suit.

(20.) MICHIGAN.

By a Territorial law approved November 25, 1817,⁴ it was enacted that if any person should wilfully or negligently set fire to, or cause to be fired, any woods, prairies, or other grounds not his own property, or should wilfully or negligently permit fire kindled by himself or by his

¹*Acts and Resolves of the Prov. of Mass. Bay, 1742-50*, p. 264.

²*Ib.*, 647.

³*Ib.*, 683.

⁴*Territorial Laws of Michigan*, i, 500; adopted from the laws of Ohio.

order or permission, to pass from his own lands to the injury of other persons, he should, on conviction, be fined for each offence a sum not over \$100, for the benefit of the county, besides being liable for damages.

In the revision of 1846¹ the above statute was continued, excepting that the offence was declared a misdemeanor, punishable by a fine not exceeding \$1,000, or by imprisonment in the county jail not over one year, or both, at the discretion of the court. The party injured might recover double damages for losses sustained. In respect to the extinguishment of fires, the Revised Statutes of Michigan provide as follows:²

SEC. 2. Whenever the woods or prairies in any township shall be on fire so as to endanger property, it shall be the duty of the justices of the peace, the supervisor and the commissioners of highways of such township, and each of them to order such or so many of the inhabitants of such township, liable to work on the highways and residing in the vicinity of the place where such fire shall be, as they shall severally deem necessary to repair to the place where such fire shall prevail, and there to assist in extinguishing the same or in stopping its progress.

SEC. 3. If any person shall refuse or willingly neglect to comply with such order, he shall forfeit a sum not less than five nor more than fifty dollars.

Liability of Railroad Companies in Michigan in respect to Fires set by their Locomotives.

By an act revised, the law providing for the incorporation of railroad companies, and to regulate the running and management, and to fix the duties and liabilities of all railroad and other corporations owning or operating any railroad in this State, approved May 1, 1873, the following provision is made concerning liability for damages from fire:

ART. IV. SEC. 16. Any railroad company building, owning, or operating any railroad in this State shall be liable for all loss or damage to property by fire originating from such railroad, either from engines passing over such roads, fires set by company employés by order of the officers of said road, or otherwise originating in the constructing or operating of such railroad: *Provided*, That such company shall not be held so liable if it prove to the satisfaction of the court or jury that such fire originated from fire by engines whose machinery, smoke-stack, or fire-boxes were in good order and properly managed, or fires originated in building, operating, or repairing such railroad, and that all reasonable precautions had been taken to prevent their origin, and that proper efforts had been made to extinguish the same in case of their extending beyond the limits of such road when the existence of such fire is communicated to any of the officers of such company.³

(21.) MINNESOTA.

AN ACT relating to Prairie Fires.—Approved June 23, 1858.

Be it enacted, &c.:

1. That if any person or persons shall, at any time hereafter, willingly and intentionally or negligently and carelessly set on fire, or cause to be set on fire, any woods, prairies, or other grounds whatsoever in any part of this State, every person so offending shall forfeit and pay not less than five dollars nor more than one hundred dollars:⁴ *Provided*, That this section shall not extend to any person who shall set on fire or cause to be set on fire any woods or prairie adjoining his or her own farm or enclosure for the necessary protection thereof from accident by fire, by giving to his or her neighbors one day's notice of such intention: *Provided farther*, That in case the neighbors come together and participate in the burning of any wood, prairies, or grounds, the notice specified in this section shall not be necessary or given: *Provided also*, That

¹*Revised Statutes of Michigan*, 1846, chap. 45; *Compiled Laws of Mich.*, 1857, ii, 1556.

²*Compiled Laws of Michigan*, 1857, ii, 1559.

³*Laws of Michigan*, 1873, i, 539.

⁴An amendment to this act approved March 10, 1860, added the following: "And in default of payment of said fine, shall be committed to the county jail for a term of not less than thirty days nor more than three months."

this section shall not be construed to take away any civil remedy which any person may be entitled to for any injury which may be done or received in consequence of such firing.

2. The penalties provided in the foregoing section shall be recovered by action of debt before any justice of the peace in the county where such offence shall have been committed, upon complaint of any legal voter residing in the county where such offence has been committed.

3. It shall be the duty of any person who shall have any knowledge of such offence, or of any legal voter of the county in which such offence has been committed, to prosecute such offender in the name of the State of Minnesota, and all fines and penalties so recovered shall be applied to the use and support of the public schools in the township in which such offence shall have been committed.

4. All acts and parts of acts inconsistent with the provisions of this act are hereby repealed.

5. This act shall take effect from and after its passage.

Official burning of Prairie Grass. Appointment of a Superintendent.

The county commissioners of each and every county invaded by grasshoppers within this State shall, on or before the first day of April in each and every year, appoint some suitable person, whose duty it shall be to superintend the burning of prairie grass in their respective counties, and in no case permit the burning of the same before the fifteenth day of May in each and every year. (*Statutes of Minnesota, Edition of 1878; chap. 95, § 67, p. 901.*)

(22.) MISSISSIPPI.

AN ACT to prevent Damages which may happen by the Firing of Woods, Marshes, and Prairies.¹—
(Approved February 16, 1828.)

SECTION 1. *Be it enacted, &c.,* That whosoever shall, at any time, wilfully set on fire any woods, marshes, or prairies within this State, so as to occasion any loss, damage, or injury to any other person, every person so offending, and being thereof legally convicted in the circuit court of the county in which the offence is committed, shall pay a fine not exceeding five hundred dollars and not less than fifty dollars; the one-half of such fine to be paid into the literary fund, and the other half to the county treasurer, for the use of the county, and any person who shall wilfully set on fire any woods marshes, or prairies shall be fined in a sum not exceeding one hundred dollars, to be received and paid as aforesaid, although no private injury ensue thereby.

SEC. 2. *And be it enacted,* That every person who shall set fire to any wood, marsh, or prairie within this State, and thereby occasion any loss, damage, or injury, to any other person, shall be, and is hereby declared liable to make satisfaction for the same in an action or actions on the case to be brought by the party aggrieved in any court of record within this State having competent jurisdiction, or, if the party injured shall not demand above fifty dollars for his loss or damage, it shall or may be lawful for such person to apply to any justice of the peace of the county where the offence is committed, who is hereby empowered and required by his warrant to cause the party offending to be brought before him, or some other justice of the peace of the same county; and if upon examination it shall appear to the justice, by the testimony of one or more creditable persons, that the defendant is guilty of the charge exhibited against him, then the said justice shall issue his warrant to three householders of the county, commanding them in the presence of the defendant, if he will be present, to view the place or thing damaged, or inquire into the loss sustained by the plaintiff, and to certify to the said justice, upon their oath or affirmation, what damage, in their judgment, the plaintiff hath sustained by occasion of the premises; and upon the return of said certificate to the said justice, he is hereby directed to grant execution for the recovery of said damages, together with costs of prosecution, as is usual in the recovery of debts under fifty dollars.

SEC. 3. *And be it further enacted,* That nothing in this act shall be construed so as to prevent any person or persons from setting on fire any wild unappropriated domain within this State, whether the same be woods, marsh, or prairie, between the first day of February and the first day of May in every year hereafter, or from setting on fire any rubbish, leaves, or brush in the farm or plantation of such person or persons, as often as occasion may require, if the same be done without the intention of setting on fire the adjacent woods, marshes, or prairies not owned, possessed, or occupied by such person.

SEC. 4. *And be it further enacted,* That when any offence shall be committed under this act by any slave or servant with the knowledge or command of his or her master or mistress, then his or her master or mistress shall be liable for and bound to pay the

¹*Laws of Mississippi, 1824 to 1838, page 159.*

finer imposed by this act, and all damages as aforesaid, which payment shall be enforced by execution as in ordinary cases.

SEC. 5. *And be it further enacted*, That whenever any offence shall be committed against the provisions of this act by any slave or servant without the knowledge of his or her master and mistress, and shall be thereof convicted before any justice of the peace where such offence shall be committed, the said justice shall thereupon sentence such slave or servant to receive thirty-nine lashes on his or her bare back; and any sheriff or constable of the said county may be required to execute the same.

SEC. 6. *And be it further enacted*, That the provisions of this act shall only extend to and be in force in the counties of Hancock, Green, Perry, Wayne, and Jones; and all acts and parts of acts coming within the purview and meaning of this act shall be, and the same are hereby, repealed.

(23.) MISSOURI.

The general statutes of Missouri¹ provide a penalty of from \$50 to \$500 for the wilful firing of any woods, marshes, or prairies so as to occasion damage to any other person, one-half of the penalty going to the person suing for the same, and the other half to the county in which the offence is committed.

For wilfully setting on fire any woods, marshes, or prairies not his own a person might formerly be fined \$100 without reference to damages, but in 1877 this statute was amended in this respect so as to make the penalty imprisonment one year, or a fine of \$500.²

(24.) MONTANA TERRITORY.

The statutes of this Territory provide as follows:³

SEC. 178. Any person who shall carelessly set fire to any timber, woodland, or grass, except for useful or necessary purposes, or who shall at any time make camp fire, or shall light any fire for any purpose whatever, without taking sufficient steps to secure the same from spreading from the immediate locality where the same may be used, or shall fail, in any instance, to put out or extinguish said fire before leaving or abandoning the same, shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be fined in any sum not exceeding one hundred dollars, and shall be liable for all damages resulting from such act.

SEC. 179. Any person who shall wantonly or designedly set fire to any timber, wood, or grass, for other than necessary purposes, or who shall, from a malicious intent, fail to extinguish any fire, after making the same for a necessary purpose, before leaving or abandoning the same, shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be fined in a sum not less than one hundred dollars, nor more than five hundred dollars, and be imprisoned in the county jail not less than one month, nor more than six months.

(25.) NEBRASKA.

The law of this State in reference to fires is as follows:⁴

SEC. 160. If any person or persons shall, at any time hereafter, willfully and intentionally, or negligently and carelessly, set on fire, or cause to be set on fire, any woods, prairies, or other grounds whatsoever in the inhabited parts of this Territory, every person so offending shall, on conviction, be fined in any sum not less than five dollars nor more than one hundred dollars: *Provided*, That this section shall not extend to any person who shall set on fire, or cause to be set on fire, any woods or prairies adjoining his or her own farm, plantation, or inclosure, for the necessary preservation thereof from accident by fire, between the first day of March and the last day of November, by giving to his or her neighbors two days' notice of such intention: *Provided also*, That this section shall not be construed to take away any civil remedy which any person may be entitled to for any injury which may be done or received in consequence of such firing.

(26.) NEVADA.

*Of the Firing of Woods:*⁵

SEC. 148. If any person or persons shall willfully and intentionally, or negligently and carelessly, set on fire, or cause or procure to be set on fire, any wood, prairies,

¹Chapter 81, p. 336.

²Act of April 13, 1877.

³Codified statutes of Montana Ter., 7th session 1871-'2, section 178, page 310.

⁴*Revised Statutes of Nebraska*, chap. 14, sec. 162, page 628.

⁵*Laws of Nevada*, 1861, page 87, sec. 148.

grass, or other lands, or grounds, in this Territory, every person so offending shall, on conviction before any court of competent jurisdiction, be fined in any sum not less than two hundred dollars, or by imprisonment in the county jail not less than ten days nor more than six months, or by both such fine and imprisonment, in the discretion of the jury trying the case; *Provided*, That this section shall not extend to any person or persons who shall set on fire any wood, prairies, grass, or other lands adjoining their own farm, house, plantation, or inclosure, for the necessary preservation thereof from accident or injury by fire, by giving to his or her or their neighbors reasonable notice of such intention.

(27.) NEW HAMPSHIRE.

AN ACT for the prevention of fires.¹—(Approved July 8, 1862.)

Be it enacted, &c.,

SECTION 1. If any person kindles a fire by the use of fire-arms while hunting or fishing, or by any other means, on land not his own, he shall be punished by a fine not exceeding ten dollars; and if such fire spreads and does any damage to the property of others, he shall be punished by a fine of not less than ten dollars nor more than one thousand dollars, or by imprisonment not less than one month nor more than three years, according to the aggravation of the offense.

SEC. 2. If any person, for a lawful purpose, kindles a fire on his own land, or on land which he occupies or is laboring upon, at an unsuitable time, or in a careless and imprudent manner, and thereby injures or destroys the property of others, he shall be punished by a fine of not less than ten dollars nor more than one thousand dollars, according to the aggravation of the offense.

SEC. 3. If any person, with the intent to injure another, kindles or causes to be kindled, a fire on his own or another's land, and thereby the property of any other person is injured or destroyed, he shall be punished by a fine not less than thirty dollars nor more than two thousand dollars, or by imprisonment not less than six months nor more than three years, according to the aggravation of the offense.

SEC. 4. All fines provided for in this act shall inure, one-half for the benefit of the person or persons injured, and one-half to the use of the county in which the offense is committed.

SEC. 5. This act shall take effect from its passage. (Approved July 8, 1862.)

Responsibility of Railroads with respect to Fires.

The general laws of New Hampshire provide as follows in relation to the damage done by fires that are kindled from railroads:²

SEC. 8. The proprietors of every railroad shall be liable for all damages which shall accrue to any person or property by fire or steam from any locomotive or other engine on such road.

SEC. 9. Such proprietors shall have an insurable interest in all property situate on the line of such road exposed to such damage, and may effect insurance thereon for their own benefit.

SEC. 10. Any insurance effected by the owner of such property thereon shall so far inure to the benefit of the proprietors of such railroad that in case of loss such proprietors shall be entitled to a deduction from the damages of the amount received thereon, except the premium and expense of recovering the same, or to an assignment of the policy upon payment of the whole damages sustained.

(28.) NEW JERSEY.

By a colonial statute of 1729-'30, the firing of woods at any time excepting between the 19th of February and the 19th of April was forbidden under a penalty of 40 shillings, to be recovered by any person who might sue for the same, besides damages. This was not to hinder any person from setting fires on his own land, if he did not suffer it to run off upon the property of another, in which case he was to pay the damages that it might occasion.

This act, originally limited to woods, was extended July 31, 1740, to marshes and meadows, and the proceedings in prosecutions were more

¹*Laws of New Hampshire, 1862, p. 2606.*

²*General laws of New Hampshire, chap. 162, p. 388.*

fully prescribed. By a supplementary act of June 20, 1765, in which it is declared that the former had not answered its intentions, the penalty was increased to a fine of twenty pounds, or, if unable to pay, the offender might be imprisoned, at the discretion of the court. The judges were to charge grand juries to inquire into cases of violation of the law, and to bring in indictments as they found occasion. One-half of the penalty was to go to the informer, and the other half to the overseers of highways of the town where the offense was committed. This law was not to hinder the owners of salt and fresh marshes and meadows from burning them over, as formerly practiced.

This act remained in force until superseded by one dated November 24, 1792, when the penalty of firing as above was fixed at not more than \$100, or imprisonment at hard labor for not more than one year, or both, besides paying double damages. In this law there was no time permitted for burning, and the right of burning marshes and meadows was continued as heretofore.

In relation to the extinguishment of fires, this act provided as follows:

SEC. 2. When the woods in any part of this State shall be on fire, the justices of the peace, the constables, and the overseers of highways residing in the vicinity of said fire shall, and they are hereby severally authorized and required forthwith to order such and so many of the inhabitants within their respective jurisdictions as they shall severally deem necessary to repair to the place where such fire shall prevail, and there to assist in extinguishing or stopping the progress of the same; and if any person, so ordered to assist in manner aforesaid, shall refuse or neglect to comply with such order, he shall forfeit and pay one dollar for every day he shall so neglect or refuse to obey, to be recovered, with costs, before any justice of the peace of the county where such notice has been given, and the oath or affirmation of the person who shall give such order shall be sufficient evidence whereon to convict such offender; and the forfeiture so recovered shall be applied as a reward to such person or persons as the officers aforesaid, or a major part of them, shall deem best entitled thereto for superior exertion at the extinguishment or in stopping the progress of such fire.

Responsibility of Railroads with Respect to Fires.

SEC. 15. It shall be the duty of every railroad company in this State, and of every company or person operating or using any railroad in this State with a locomotive engine or engines, to provide such engine or engines with a screen or screens, or cover or covers, on the smoke-stack or smoke-pipe of such engine or engines, so as to prevent as much as practicable the escape of fire, either from wood, soft coal, or hard coal, from the smoke-stack or smoke-stacks, smoke-pipe or smoke-pipes of said engine or engines.

SEC. 16. In any action now or hereafter brought for the recovery of damages for an injury done to the property of any person or corporation by fire communicated by a locomotive engine of any person or railroad corporation, in violation of the preceding sections of this act, proof that the injury was so done shall be *prima facie* evidence of such violation, subject, nevertheless, to be rebutted by evidence of the taking and using all practicable means to prevent such communication of fire as by said section required.

SEC. 17. If any company or person shall refuse or neglect to comply with either of the foregoing provisions of this act for preventing the communication of fire from locomotives, they shall forfeit for every such refusal or neglect the sum of one hundred dollars to any person who may sue for the same, to be recovered with costs in an action of debt in any court having cognizance thereof, one-half of the sum recovered to go to the person suing, and one-half to the State for the public school fund.

SUPPLEMENTARY ACT. Approved March 27, 1874. [By this amendment the foregoing act was to apply only where the cause of action upon which a suit is brought arose or accrued since the fourth day of July, 1873. So much of the act as was inconsistent with this provision was at this time repealed.—*Revision of New Jersey, 1709-1877, p. 943.*]

(29.) NEW YORK.

The "Duke's laws" of 1672 forbade the kindling of fires on commons, or on one's own lands so as to escape into the enclosures of neighbors,

under a penalty of all damages to the owner, and half as much more for a fine. If not able to pay, he might be punished by not exceeding twenty stripes, or might be required to do service to expiate his crime. By an amendment of 1683 the penalty was reduced to damages.

An act was passed by the General Assembly November 25, 1710, applicable to Long Island and New York Island and for three years only, the setting of fire, to any upland, plains, woods, trees, shrubs, under-wood, or brush, under a penalty of forty shillings, or imprisonment until such fine was paid, besides the damages that such fire might occasion.

By an act for extinguishing fires in the woods in the counties of Albany and Ulster, passed November 8, 1760, the inhabitants of the several towns, precincts, etc., were empowered at their annual meetings to elect such a number of their freeholders as by a majority should be judged needful, to be known as *firemen*. The persons so chosen were empowered, upon view and information of any fire happening in any part of the woods within their respective districts, or the woods adjacent thereto, whereby any of the inhabitants might be in danger of being damaged, to require and command every able man residing within their districts to aid and assist the said firemen, or any one of them who should happen to be near or discover the fire, in extinguishing the same. Any person who, without lawful excuse or impediment, should refuse, neglect, or delay to help and assist when so required was to forfeit the sum of three shillings for each refusal, delay, or neglect.

This law, first limited to six years, was renewed December 19, 1766, and extend to include Ulster County. The same provisions and penalties were enacted, with the additional clause that if any fireman duly elected should neglect or refuse to do duty, he was to forfeit for each neglect the sum of £2 [\$5] for each occasion.

The existing statute of New York against the setting of forest fires is as follows:

Of the Firing of Woods.¹

SECTION. 1. Every person negligently setting fire to his own woods or negligently suffering a fire kindled upon his own wood or fallow land to extend beyond his own land shall forfeit treble damages to the party injured thereby. Every person so offending shall also be deemed guilty of a misdemeanor, and on conviction shall be punished by a fine or imprisonment, or both, at the discretion of the court, such fine not to exceed one thousand dollars, and such imprisonment not to exceed one year.

SEC. 2. Whenever the woods in any town shall be on fire, it shall be the duty of the justices of the peace, the supervisor, and the commissioners of highways of such town, and each of them, to order such and so many of the inhabitants of such town liable to work on the highways and residing in the vicinity of the place where such fire shall be as they shall severally deem necessary, to repair to the place where such fire shall prevail, and there to assist in extinguishing the same or in stopping its progress.

SEC. 3. If any person so ordered to repair to and assist in manner aforesaid shall refuse or neglect to comply with any such order, he shall forfeit and pay the sum of fifty dollars, and shall also be deemed guilty of a misdemeanor, and on conviction shall be punished by fine or imprisonment, or both, at the discretion of the court, such fine not to exceed one hundred dollars, and such imprisonment not to exceed sixty days.

SEC. 4. Every forfeiture recovered under the last section shall be applied as a reward to such person or persons as the officers above mentioned, or a majority of them, shall deem best entitled thereto for superior exertions in extinguishing or stopping the progress of such fire.

SEC. 5. No person shall hereafter set fire to or burn any coal kiln in the county of Suffolk except during the months of December, January, and February; any person offending against the provisions of this section shall be deemed guilty of a misdemeanor, and on conviction shall be punished by imprisonment in a county jail for a term not

¹*Revised Statutes of New York* (6th Ed.), Vol. 2, p. 985.

exceeding one year, or by a fine not exceeding one thousand dollars, or by both such fine and imprisonment.

SEC. 6. Any person or persons who shall set fire to or burn any coal kiln, or shall permit or suffer the same to be done on his land except at the times above mentioned, shall be liable in twice the amount of any damage occasioned thereby, to be sued for and recovered with costs of suit in any court having cognizance of the same, by the party injured thereby, against the owner of the land on which the said coal kiln shall be burned.

(30.) NORTH CAROLINA.

AN ACT to prevent Burning the Woods.¹

Whereas the frequent burning of the woods is found to be destructive to cattle and hogs, extremely prejudicial to the soil, and oftentimes of fatal consequences to the planters and farmers by destroying their fences and other improvements; for prevention of which evils,

II. *Be it enacted by the General Assembly of the State of North Carolina, and it is hereby enacted by the same*, That it shall not be lawful for any person whatsoever to set fire to any woods except it be his own property, and in that case it shall not be lawful for him to set fire to his own woods without first giving notice to all persons owning lands adjacent to such woodlands intended to be fired, at least two days before the time of setting such woods on fire, and also taking effectual care to extinguish such fire before it shall reach any vacant or patented lands contiguous to or adjacent such lands so fired.

III. [Provided for otherwise by act, April, 1792, ch. 29.]

IV. *And be it further enacted by the authority aforesaid*, That if any slave, or mulatto, or vagrant person, unable to pay the said fine aforesaid, shall be convicted of setting fire to any woods, contrary to the true meaning of this act, such person on conviction thereof shall have and receive on his bare back thirty-nine lashes, well laid on, at the public whipping post.

AN ACT to amend an Act entitled "An Act to prevent the Burning of Woods."²

Whereas the penalties in the said act are not sufficient to answer the good purposes therein mentioned.

II. *Be it therefore enacted, &c.*, That every person offending against the said act shall forfeit and pay for every offence the sum of twenty-five pounds of specie, to be recovered by action of debt, bill, plaint, or information, to the use of the person who shall sue or prosecute for the same, and shall also be further liable to the party injured by such unlawful firing of the woods for all damages that may accrue therefrom.

(31.) OHIO.

AN ACT to prevent Firing Woods and Prairies.³—(Approved February 11, 1805.)

SECTION 1. *Be it enacted, &c.*, That if any person shall wilfully or negligently set on fire, or cause to be set on fire, any woods, prairies, or other grounds within this State, the property of any other person, or shall intentionally permit the fire to pass from his own woods, prairies or grounds, to the injury of the property of any other person, the person so offending shall, on conviction thereof, for every such offence, be fined in a sum not exceeding fifty dollars, at the discretion of the court having cognizance of the same, to be recovered by indictment, to be paid into the treasury of the county where the offence was committed, for the use of the county, and stand committed until the sentence of the court is complied with, and moreover shall be liable to the action of the party injured for damages.

SEC. 2. *And be it further enacted*, That the act entitled "An act regulating the firing of woods, prairies and other lands, passed December sixth, one thousand seven hundred and ninety-nine, and other laws and parts of laws heretofore passed on this subject, are hereby repealed. This act shall commence and be in force from and after the first day of June next.

(32.) OREGON.

SEC. 36.⁴ If any person shall wilfully and maliciously set on fire any woods, prairie, or other grounds, other than his own, or shall intentionally, or by neglect, permit the

¹*Laws of North Carolina, 1777, chap. 25* (see Pub. Acts. of N. C. from 1715 to 1790, by James Iredell), vol. 1, p. 246.

²*Laws of 1782, chap. 29.*

³*Laws of Ohio, vol. 14, chap. 49, page 238.* Substantially embodied in statutes as now in force.

⁴*Statutes of Oregon, 1855, p. 219, sec. 36.*

fire to pass his own premises or grounds, to the injury of any other person or persons, every person so offending, shall on conviction thereof, for every such offence, be fined in a sum not exceeding five hundred nor less than ten dollars.

(33.) PENNSYLVANIA.

By the "Duke's Laws," as issued in 1676, any person setting a fire in the woods was to pay all damages, and half as much more for a fine. If not able to pay the fine, he might be punished forty stripes. This was renewed in 1682 and 1693. In 1700 it was again renewed, excepting that the prohibited season of burning was "before the first day of the first month, or after the first day of the third month."

On the 29th of March, 1735, the privileged season was abolished, and persons were made liable for damages done by fires of their setting at any time of the year. If the demand for damages were less than forty shillings, a justice of the peace, he was to appoint two or more substantial freeholders to make inquiry as to the amount of loss, and upon their return he was to grant execution for recovering the same, with costs of suit, if above forty shillings, but without costs if less. If the offense were done by a slave, the master was to pay the damages, or if this be not done, the said slave was to be whipped, not exceeding twenty-one stripes on the bare back, and further stand committed until the costs of suit were paid.

By an act of April 14, 1794, the wilful setting of fires to any woods, lands, or marshes at any time so as to occasion loss to others was made punishable by a fine of not over fifty dollars nor less than twenty dollars, half to the informant and the remainder to the overseers of the poor. He was also to be liable for damages done by the fire. The proceedings in prosecutions were specified, and nearly similar to those of the colonial act, excepting that the limit of "forty shillings" was changed to "fifty dollars" and provision was made for appeal. The punishment of slaves was changed to hard labor for three months and until the costs of suit were paid.

By an act approved March 29, 1824, for preventing the destruction of timber and damages by fires, a fine not exceeding \$500 might be imposed for the wilful setting of fires, one-fourth part to the informer and the rest for support of the poor, and the person convicted might be imprisoned at hard labor for a term not exceeding one year. The class of persons for which special punishment had been ordered in former acts having ceased to exist in the State, this act was made uniform as to penalties.

A special act, limited to the counties of Clearfield, Fulton, and Elk, was enacted March 26, 1867, the wilful or negligent setting of fires to woods, barrens, or moors might be punished by a fine of from \$50 to \$300, and imprisonment not over twelve months, and the prosecution might be commenced at any time within six years. Upon every conviction the prosecutor was to receive \$50 from the county treasury, as a reward for the apprehension and conviction of the offender, and the district attorney was to receive \$20 for conducting the suit. These sums were to be recovered back from the defendant, with costs, and paid into the county treasury. The prosecutor was to be competent to appear as a witness in such cases, to establish the guilt of the defendant.

In 1868 the railroad companies in Erie County were made specially responsible for the damages that might result from fires caused by their locomotives, and by another act, passed in 1869, the intentional firing of woodlands upon mountains in Union County was made punishable

by a fine of from \$50 to \$500, and imprisonment for a term not exceeding one year.¹

The following act, which applies to the whole State (excepting Lycoming, which was exempted in 1871), provides an effectual means for reducing the number of forest fires and of diminishing their damages:

AN ACT to protect Timber Lands from Fire.²—(Approved June 2, 1870.)

Whereas it is important to the people of the State that timber lands should be protected from fire, which, owing to malicious conduct and carelessness of individuals, is causing great havoc to the young growing timber, especially upon our mountains: Therefore,

Be it enacted, &c.: That it shall be the duty of the commissioners of the several counties of this Commonwealth, to appoint persons under oath, whose duty it shall be to ferret out and bring to punishment all persons who, either wilfully or otherwise, cause the burning of timber lands, and to take measures to have such fires extinguished, where it can be done, the expenses thereof to be paid out of the county treasury, the unseated land-tax to be first applied to such expenses.

An act approved June 11, 1879, and applicable to the whole State, imposes the penalty of not more than \$300 fine, or not more than one month's imprisonment, for the wilful or wanton setting of fires on the lands of another, so as to set on fire any woodlands, barrens, or moors within the limits of the Commonwealth. Upon the conviction of any person or persons for these offenses, the commissioners of the county are required to pay to the prosecutor the sum of \$50 out of the county treasury, as a reward for the apprehension and conviction of the offender, and the defendant is required to pay this sum as costs, to the sheriff, for the use of the county.³

(34.) RHODE ISLAND.

The earliest statute relating to forest fires in Rhode Island was passed October 25, 1704, and imposed a penalty of thirty shillings in money, besides damages and costs of prosecution, for the setting of fires at any time of the year except between the 10th of March and 10th of May, when they were allowed.

It being found that the penalty was too small, it was increased in 1722 to \$10; and if the person had no personal estate to satisfy the same, he might be imprisoned, at the discretion of the court, for a time not exceeding three months, or might be whipt not exceeding thirty-nine stripes.

In 1798 or a little previous the privileged season was abolished, and the penalty fixed at \$20 for the first offense and \$40 for the second, one-half to the informer and the remainder for the use of the poor. Upon refusal to pay, the offender might be imprisoned in the county jail, "there to be kept until he or they shall satisfy and pay such fine and cost, or be, by order of the court, sold for payment thereof." Those suffering injuries from fires thus set were to have an action of trespass against the offender, and might recover damages and costs.

By a subsequent act, the punishment for setting of fires to run and spread at large in the woods, at any time, under any pretext, was to be punished by imprisonment not exceed one year.⁴

¹By an act approved June 2, 1870, this act was extended to include the counties of Schuylkill, Lehigh, Berks, Lycoming Centre, Snyder, and Luzerne.

²*Laws of Pennsylvania*, 1870, No. 1206, p. 1316.

³*Laws of Pennsylvania*, 1879, No. 176, p. 162.

⁴*Public Laws of Rhode Island* (1844), p. 382; *Revised Statutes* (1857), Title XXX, chap. 214, page 533.

The present statute of this State is as follows:

Every person who shall wilfully or carelessly set, or cause any fire to be set, in the woods in any part of this State, to run and spread at large, at any time of the year, under any pretence whatsoever, shall be imprisoned not exceeding two years.¹

(35.) SOUTH CAROLINA.

An act passed in 1789 prescribed a penalty of £5 for the setting of fires to grass, brush, or other combustible matter, so as thereby to burn the woods, fields, or marshes. In default of payment, the offender might be imprisoned for a term not exceeding two months, and he was further liable for any damages that the fire might occasion. This was not to hinder any person from setting fires on his own premises, provided that he did not allow them to escape to the injury to his neighbors. If done by a slave, his master was to pay the damages and costs of suit, and the slave was to be punished by not over thirty-nine stripes.

The captains of militia were required to cause this ordinance to be read at the head of their respective companies at least once in six months, on pain of being chargeable with neglect of duty and of being proceeded against by court-martial, in case they omitted to do so.

The present law of this State upon this subject, enacted December 21, 1857, renders the wilful and malicious burning of grass, brush, or other combustible matter, so as to set on fire any woods, fields, fences, or marshes, punishable by fine and imprisonment at the discretion of the court. The offender is further liable to all damages that may result, and to costs of prosecution for the same.²

AN ACT to increase the Penalty for setting Fire to the Woods.—(Passed December 21, 1857.)

SECTION 1. *Be it enacted by the Senate and House of Representatives, now met and sitting in General Assembly, and by the authority of the same, That any person who shall wilfully and maliciously set fire to or burn any grass, brush, or other combustible matter, so as thereby any woods, fields, fences, or marshes of any other person or persons be set on fire, or cause the same to be done, or be thereunto aiding or assisting, shall, upon indictment and conviction thereof, be liable to fine and imprisonment, at the discretion of the court, and shall, moreover, be liable to the action of any person or persons who may have sustained damage thereby.*—*Laws of South Carolina 1857, page 617.*

(36.) TENNESSEE.

Code enacted in 1857-8.

[Part I, Title 12, page 358. Thompson & Steger's Statutes, 1871, §§ 1703-'5.]

CHAPTER 8.—OF BURNING WOODS.

§ 1703. No person shall set fire to any woods not his own property, nor to his own without giving at least two days' notice to persons owning the adjacent lands, and also taking effectual care to extinguish such fire before it extends beyond his own lands.

§ 1704. Any person violating the preceding section shall forfeit one hundred dollars to any person who shall sue therefor, and shall also be liable to any party injured for all damages which may accrue therefrom.

§ 1705. If any slave, free negro, or person who is unable to pay the fine is convicted of the violation aforesaid, he shall, if a slave or free negro, be punished by not exceeding thirty-nine stripes; if a vagrant,³ by imprisonment in the county jail not exceeding one month.

¹*General Statutes of Rhode Island (1872), Title XXX, chap. 230, page 544.*

²*Laws of South Carolina 1857, p. 617; Revised Statutes of South Carolina 1873, p. 717.*

³In a note to Thompson & Steger's Edition it is remarked that the term "vagrant" here probably refers to white persons. The original act reads "slave, free negro, or mulatto or vagrant person."

(37.) TEXAS.

[Paschal's Digest, Laws of Texas, 2d Ed., p. 459.]

ART. 2333 [702.] If any person shall wilfully burn or cause to be burned any woodland or prairie not his own, at any time between the 1st of July and the 15th of February succeeding, he shall be fined not less than fifty dollars nor more than three hundred dollars.

ART. 2334 [703.] The offence named in the foregoing article is complete where the person offending sets fire to his own woodland or prairie, and the fire communicates to the woodland or prairie of another.¹

(38.) UTAH.

The laws of Utah declare it as a misdemeanor to maliciously or negligently to set fire, or cause or procure to be set on fire, any woods, prairies, grasses, or grain, on any lands, public or private, but do not specially prescribe the penalties.²

(39.) VERMONT.

By an act passed March 4, 1797, the wilful or imprudent firing of lands, or the wilful or careless suffering of such fires to spread, whereby damage was done to other persons, was made punishable by double damages, to be recovered in an action of trespass, with costs of suit.³

In 1839 a punishment was provided by fine and imprisonment in the county jail for a term not exceeding six months.⁴

In 1849 railroad companies were made liable for the fires that their locomotives might occasion, unless they could show that they had used all due caution and diligence, and employed suitable expedients to prevent such injury. They were to have an insurable interest in the property along the line of their road.⁵

The existing statute upon the subject of forest fires is as follows:

If any person shall wilfully and maliciously set on fire, or cause to be set on fire, any woods or forests, so as to occasion injury to any person * * * he shall be punished by fine not exceeding \$200, or by imprisonment in the county jail not exceeding six months.⁶

(40.) VIRGINIA.

By an act passed January 16, 1802, the setting of fire to woodlands, unless by accident, was made punishable by a fine of \$30, to be recovered with costs of suit, half to the informer and the other half to the county. If done by a person under eighteen years of age, the parent, guardian, or master became liable, and if by a slave, the master. In the latter case, if the fine were not paid, the slave was to receive thirty lashes by order of a justice of the peace.

In 1835 the penalty was increased to a fine of not more than \$100,

¹ *Paschal's Digest, Laws of Texas*, 2d Ed., p. 459. As enacted March 18, 1848 (*Laws of Texas* 1847-'8, p. 138), the penalties were to be not less than \$10 nor more than \$50, besides damages and costs of suit. In default of payment, the accused might be imprisoned until the fine and costs were paid. The defendant might demand a trial by jury, and upon this a jury of six men might be summoned to examine the facts and assess the fine.

² *Compiled laws of Utah*, 1876, p. 612.

³ *Laws of Vermont*, 1797, p. 190.

⁴ *Revised Statutes of Vermont*, 1839, 432, p. 233.

⁵ *Compiled Statutes of Vermont*, 1850, p. 204, *General Statutes of Vermont* 2d Ed., 1870, p. 233.

⁶ *General Statutes of Vermont*, 1870, p. 673.

and imprisonment not less than two nor more than twelve months. The person was also to become liable to the injured parties for the damages and costs of their recovery. If done by a slave, it was to be deemed a felony, and if by a free colored person, the person might be punished by stripes not exceeding thirty-nine. The grand juries were to be charged at the circuit and superior courts, and the county courts to make inquiries as to the offences done in violation of this act.¹

In the code of 1873 these provisions, except as to distinction of persons, are continued, and the damages are to be awarded at the discretion of a jury.

(41). WASHINGTON TERRITORY.

AN ACT to protect Forests and Timber Lands from Fires, and careless Kindling of Fires. (Approved November 6, 1877.)

Be it enacted, &c.:

1. That if any person shall kindle a fire in any field, pasture, or inclosure, forest, prairie or timber land not his own, without the consent of the owner, and the same shall spread and do damage to any buildings, fences, crops, cord-wood, bark, or other personal property, or to any wood or timber land, he shall on conviction be punished by a fine of not less than ten, nor more than five hundred dollars, and costs, according to the aggravation of the offense, and shall stand committed till the fine and costs are paid.

2. If any person shall maliciously, with intent to injure any other person, by himself or any other person kindle a fire on his own land, or the land of another person, and by means of such fire the buildings, fences, crops or other personal property, or wooded timber lands of any other person shall be destroyed or injured, he shall on conviction be punished by a fine of not less than twenty dollars, nor more than one thousand dollars, or by imprisonment in any of the jails of this Territory not less than three months, nor more than twelve months, according to the aggravation of the offense.

3. If any person shall for any lawful purpose kindle a fire upon his own land he shall do it at such time and in such manner and shall take such care of it to prevent it from spreading and doing damage to other person's property as a prudent and careful man would do, and if he fails so to do, he shall be liable in an action on the case to any person suffering damage thereby, to the full amount of such damage.

4. Any person who shall enter upon the lands of another person for the purposes of hunting or fishing, and shall by the use of fire-arms or other means kindle any fire thereon, he shall be liable to the penalties of the first or second sections of this act, as the case may be.

5. Persons engaged in driving lumber upon any waters or streams in this Territory may kindle fires when necessary for the purposes in which they are engaged, but shall be bound to use the utmost caution to prevent the same from spreading and doing damage; and if they fail to do so, they shall be subject to all liabilities and penalties of this act in the same manner as if the privilege granted by this action [section ?] had not been allowed.

6. The common law right to an action for damages done by fires is not taken away or diminished by this act, but it may be pursued, notwithstanding the fines or penalties set forth in the first and second sections of this act; but any person availing himself of the provisions of the third section, be barred of his action at common law for the damages so sued for, and no action shall be brought at common law for kindling fires described in the fifth section; but if any such fires shall spread and do damage, the person who kindled the same, and any person present and concerned in driving such lumber, by whose act or neglect such fire is suffered to spread and do damage, shall be liable in an action on the case for the amount of damages thereby sustained.

7. This act shall take effect and be in force from and after its passage and approval by the governor.

(42). WEST VIRGINIA.

SEC. 8. If any person unlawfully and maliciously set fire to any woods, fence, grass, straw, or other thing capable of spreading fire on lands, he shall be fined not exceeding one hundred dollars and confined in the jail not less than two nor more than twelve months.

9. If any person intentionally set any woods on fire, whereby damage is done to the property of another, he shall be fined at the discretion of a jury.²

¹Laws of Virginia, 1834-'5, p. 46.

²Code of West Virginia, 1868, p. 681, Chap. CXLV.

(43.) WISCONSIN.

SEC. 4406. Any person who shall willfully, maliciously, or wantonly set on fire, or cause to be set on fire, any prairie, meadow, marsh, or woodland, or other grounds of another, or who shall intentionally or by gross negligence permit any fire to run or pass from his own land to the injury of another, or who shall intentionally set on fire, or cause to be set on fire, any woods, prairie, marsh, meadow, or cranberry marsh, not his own, during the months of August, September, October, or November, shall be punished by imprisonment in the county jail not more than one year or by fine not exceeding five hundred dollars.¹

(44.) WYOMING.

AN ACT to prevent the Firing of Woods and Marshes.—(Approved November 23, 1869.)

Be it enacted, etc.:

SEC. 1. If any person shall willfully set on fire any woods, marshes, or prairies, so as thereby to occasion any damage to any other person, such person shall, upon conviction thereof, pay a sum not exceeding five hundred dollars nor less than fifty dollars and be imprisoned in the county jail not more than three months, nor less than fifteen days, and said fine shall go to the school fund of the county in which said offense was committed, and in case of the neglect or refusal of any person so convicted to pay the fine above specified, he shall be confined in the county jail one day for every three dollars thereof until said fine be discharged.

SEC. 2. If any person shall set on fire any woods, marshes, or prairies, so as thereby to occasion damage to any other person, such person shall make satisfaction for such damages to the party injured, to be recovered in an action.

SEC. 3. Nothing in this act shall be construed to apply to any person who may in the months of March and April set fire to grass upon his own land, or upon public lands unclaimed or unoccupied, which fire he shall keep within proper control, and prevent it from doing injury or doing damage to the property of others.

SEC. 4. Nothing herein contained shall be so construed as to prevent any persons from firing against fire so as to protect his or her property from being destroyed.

SEC. 5. This act shall take effect and be in force from and after its passage.

3.—LOCAL INQUIRIES CONCERNING FOREST FIRES.

(a.) *Returns from Correspondence.*

In October, 1880, a circular was issued by the department to its correspondents in the several States and Territories, with the view of ascertaining the extent of injuries that have been observed from forest fires, the causes so far as known, and the methods commonly employed for preventing or arresting these fires when started and under way. The circular invited such suggestions as might appear advisable concerning means for preventing the continued recurrence of these calamities.

In arranging these returns, we have preferred the geographical rather than the alphabetical order, as more conveniently bringing together the regions that have somewhat similar conditions.

(1.) MAINE.

Cumberland County.—Estimated area burned over in June and August, 1,000 acres, which was considered a relatively small amount, considering the drought that had prevailed. The fires were generally caused by engines, by gunning, or by setting back fires, which were deemed quite successful in checking the progress of the fires. Probable damage, \$5,000, of which \$1,000 was to forest products prepared for mar-

¹*Revised Statutes of Wisconsin*, 1878, Chap. CLXXXII, p. 1,045. By an act passed March 19, 1873, the penalty was fixed at not less than \$20 nor more than \$500 or imprisonment not less than 30 nor more than 90 days, or both, at the discretion of the court. *Laws of Wisconsin*, 1873, p. 643.

ket, and the remainder to standing timber.—(*Robie Whitney*, Sebago Lake, Me.)

Oxford County.—Fires occurred at various times from July 1 to September 10, chiefly from locomotives, from hunters, and from tramps. The area burned is estimated at 1,000 acres, and loss to standing timber, \$10,000. Some fires were spread from clearings.—(*H. Hudson*, South Bethel, Me.)

Penobscot County.—Frequent fires are mentioned as occurring in the State through the summer months, commencing about May 1; but it is thought not 1 per cent. of the wood lands are burned annually. The loss in the State may be \$100,000 to \$200,000 a year. The timber of all kinds is generally killed where these fires extend.—(*Henry M. Prentiss*, Bangor, Me.)

Piscataquis County.—Fires occurred about the first days of August and September, each continuing about a week. About 300 acres were burned over in Sebec, and 100 in Milo. One was caused by locomotive sparks, and one by an incendiary. The damage was limited to the timber lands.—(*O. T. Goodridge*, Milo, Me.)

Washington County.—In June, August, and September fires occurred in the eastern part of the county, in the valley of Saint Croix River, and run over an area variously estimated at from 30,000 to 40,000 acres, destroying at least \$60,000 worth of property. As much as 5,000 cords of hemlock bark were burned.—(*F. A. Pike*, Calais, Me.)

In *Androscoggin*, *Aroostook*, *Knox*, and *Sagadahoc* counties, no important forest fires had occurred during the year.

(2.) NEW HAMPSHIRE.

Cheshire County.—A fire, caused by the carelessness of hunters, burned over a hundred acres or more, on a hillside, and mostly of thin second growth. It destroyed perhaps \$100 worth of timber and twice as much in cord-wood and fences. As a general rule the railroad companies now burn over the ground along their lines, in the spring and fall, to prevent sparks from setting fires. There are usually more or less fires in every town, caused by the carelessness of smokers and boys.—(*Geo. H. Gilbert*, Keene, N. H.)

Hillsborough County.—A destructive fire occurred October 15, in the woods in Brookline and Mason, sweeping over more than 600 acres. About two hundred men had been fighting it, and mills and houses were in danger. An effort was being made to obtain assistance from Nashua.—(*Newspaper account*.)

In *Carroll*, *Stratford*, and *Sullivan* counties no important forest fires had occurred during the year.

(3.) VERMONT.

Returns from ten counties show that no fires of much importance had occurred during the year, or in recent years, in this State. In Rutland County a few hundred dollars' worth of property had been burned from fires set by campers.

(4.) MASSACHUSETTS, RHODE ISLAND, AND CONNECTICUT.

No very important forest fires were reported. In Connecticut, near the New York line, several hundred acres were burned over in August

or September. The fire is supposed to have been the work of an incendiary. It was sprout land, and the damage was valued at about \$2,400.

(5.) NEW YORK.

Franklin County.—In the early part of the season a fire occurred in the towns of Malone and Belmont, which swept over perhaps 2,000 acres, of which 500 were green timber, the rest being on the track of former fires. In the fall, a fire occurred in Westville, Bombay, and East Covington, burning over perhaps 500 acres of second growth. The first of these fires was in spruce and hemlock, with some hardwood, worth perhaps \$2 per acre. The second was on much better land, but less heavily timbered. These forest fires practically make the land worthless. The timber constitutes its main value, and nobody will undertake to clear up a burnt district. In answer to the question "What measures can you suggest as applicable in your region for preventing the occurrence, or for limiting the spread of these fires?" the correspondents, who control some 35,000 or 40,000 acres of timber land, and are extensively engaged in lumbering operations, say:

(1.) Open the eyes of the people to the danger, the immense destruction of property, the rapidly-shrinking streams, the increase and duration of drought, the blighting of landscape, and the general and climatic effect. This can be done by national publications fitted for the common people, not by documentary reports. Force these upon the attention of all by tracts or placards, in the places of summer resort, in lumbering camps, and all centers of population adjacent to the forests.

(2.) By stringent national and State laws, fastening responsibility upon careless guides and tourists, and also upon those who are clearing land. When a man wishes to burn a fallow piece, he should girdle it with a swath, cleared by the axe. In this section almost no attention is paid to this: responsible men, who would not think of endangering a neighbor's house by a bonfire, in their garden, think nothing of letting loose their fallow fires into adjoining timber.

In reference to these fires in Northern New York, they say:

The northern part of the Adirondack wilderness is scarred all over with these fires. In some places miles in length and breadth of valuable timber and smiling landscape are desolated, our brooks are drying up, our rivers shrinking till the water-power threatens future extinction. The rainfall has decreased within very recent memory. The danger is great and pressing. (*A. B. Parmelee & Son, Malone, N. Y.*)

Jefferson County.—About 800 acres in Jefferson and Lewis Counties were burned from August 1 to October 20; mostly started from the burning of fallows, of which from 75 to 100 acres were standing timber. About 3,000 cords of coal-wood, and 40,000 bushels of coal were lost. There was but poor success from plowing and shoveling sand, it being a very dry season. The best preventive is in strict legislation in the matter of starting fires. (*R. N. Gere, Carthage, N. Y.*)

Oswego County.—Limited fires have occurred in Volney, set from locomotive sparks, burning over small tracts of woodland and meadows with dry sod, and a few barns, etc., in various parts of the county.—(*H. N. Gilbert, Fulton, N. Y.*)

Saint Lawrence County.—Last year, fires seemed to be everywhere in the county, and considerable damage was done; the present year has in a great degree escaped.—(*W. N. Knox, Canton, N. Y.*)

Most of the forest fires that have heretofore occurred in the county have been occasioned by the clearing of land, and have spread among the standing timber, in which much dry and inflammable material is scattered, many trees having been left on the ground after stripping off the bark. Care in the burning off of clearings, and by campers would prevent most of these fires.—(*G. H. Clarke, Fullerville, N. Y.*)

Suffolk County.—Fires occurred in May and June, being started by railroad sparks, careless persons, and tramps, which may have destroyed from \$10 to \$12,000 worth of small timber, and \$800 to \$900 of other property. It would be advisable to make the roads wider, as a better means of defense. In former years, large portions of the woodlands of the county have been burned over, so that now there is not much *debris* and young growth at the surface to carry the fires, and there is more force at hand to extinguish them when started, unless there is a strong wind.—(B. A. Merritt, Breslau, N. Y.)

At Patchogue, May 13, a newspaper account reported a dense fire as burning both east and west of that place for some hours, and destroying many thousands of dollars worth of property. The fire bordered the Long Island Railroad, and was supposed to have originated from sparks from the pipes of tramps, who had rested in the woods the day before.

Sullivan County.—The mountains of this county have in recent years been overrun with forest fires, causing immense losses to property of every kind that lay in their way. On the 30th of August, 1876, during a severe and protracted drouth, which had prevailed for some weeks, the fires got beyond control in the country around Port Jervis, Woodbourne, Fallsburgh, and other places in Sullivan County, as also on the mountains in Pennsylvania adjacent. The forests to the southwest of Pond Eddy suffered severely by these fires. They also overrun the country along the line of the Port Jervis and Monticello Railway.

Ulster County.—Large fires are burning on the eastern slope of the Catskills and the adjacent foot-hills, and Woodstock Mountain west of Mead's summer hotel, has been covered with flame and smoke all the afternoon. All the surrounding citizens of Woodstock village have been ordered out to fight the fire. A strong wind has been blowing all day, and the air is thick with smoke at Kingston.—(Newspaper account. May 17, 1880.)

Warren County.—Extensive forest fires were reported near Caldwell, in May, destroying a large amount of property in that region. The Prospect Mountain House, at Lake George, was burned by these fires May 17, and the Fort William Hotel was in danger.

(6.) NEW JERSEY.

In Atlantic County it was estimated that the area burned over in the early part of 1880 was some 50,000 acres. The fires were started by sparks from railroad trains, the burning of brush in the clearing of land, by tramps, and other causes not known.

The estimates of loss vary, and might average three dollars to the acre for wood land, not including the damages done to vineyards and buildings.

Eight dwellings and twenty-nine barns were destroyed. In the absence of water, the progress of the fire was checked by throwing fresh earth.

It was found difficult in many cases to render the roads available for stopping the progress of the fire, on account of their narrowness, which, in some cases, was not more than 8 or 10 feet. Had they been kept clear of combustible material to the width of three or four rods, they might have proved of much greater service in arresting the fires.

This county suffered from forest fires in 1820, 1829, 1832, 1833, 1857, 1858, 1859, 1865 and 1872. (John H. Doughty, Absecon, N. J.)

Burlington, N. J.—In the spring, during an unusual drought, which

continued some four weeks, a most disastrous fire occurred in the timber lands of this county, sweeping over about a third part of the forest area. They originated from locomotive sparks, coalpits and clearings, and, as some suppose, from incendiaries, who wish to buy the dead timber cheaply for coaling. The estimated area of the burned district was 40,000 acres, and the loss from \$10 to \$30 per acre, except in cedar timber, in which the value may range from \$100 to \$1,000. The loss may be estimated at \$130,000. Besides standing timber, there was a loss in charcoal, wood and rails, that might amount to \$15,000; some buildings, usually not valuable, fences, stocks, &c., were burned, worth perhaps \$9,000 more. So much loss has been occasioned in this county by incendiary fires, that the owners of timber lands in this county have organized a timber-protection company. Depredators have been cutting and selling timber from lands of non-resident owners, and to prevent this, individual owners and this society are offering rewards for their detection, and punishing the guilty when convicted, and it is thought that some of these fires have been set in revenge.—(*T. J. Beans*, Moorestown, N. J.)

A newspaper account dated Atsion, May 14, says:

The fierce forest fires now burning in this region alone are reported as destroying over 100 square miles of arable, berry bog and timber land and vineyards. Great Republic, a prosperous village, is now in a state of desolation. Monday night's fire destroyed no less than twenty-two buildings in and about the village. At Bennett's mills, two houses in the path of the flames were consumed. From Great Republic the fire took a southeasterly course towards the iron mills and Cedar Lake, and skirting about Hammonton and Ellwood, spread towards Mullicus River on the northeast and Great Egg Harbor River on the southeast.

A correspondent in Burlington County, New Jersey, writes:

I have had under my care large tracts of growing timber, and have had very little loss from fires. Our plan is to burn over our tracts early in spring, before the sap starts—burning up all the underbrush, leaves, &c. We have found that a fire in February does not hurt the growing timber; and should summer fires come in from adjoining property that has been neglected, they have nothing to feed on but very green leaves, &c., and they are much more easily controlled. Even if they go through the woods they find little to burn; they get up but little heat, and do but little damage. The Pemberton and New York Railroad runs through our tract, and summer fires are common, but they hardly require looking after, so far as our tract is concerned. I think there should be a law requiring every owner of timber and brush land in our general pineries, to burn all the leaves that may fall during the winter, thus leaving no fuel for summer fires.

Camden County, &c.—Very destructive forest fires occurred in this county, at intervals, from the middle of May to the last of June. They were occasioned by locomotive sparks and by accident, and in Atlantic, Burlington, Camden, Cape May, Cumberland, and Ocean Counties the area burned will exceed 200,000 acres. It is difficult to estimate the loss, which cannot be less than \$500,000, and is probably much more. Some fences were burned, but very few buildings. The value of timber land near the railroad is merely nominal, as fires are of such frequent occurrence.—(*J. W. Nicholson*, Camden, N. J.)

Another account, referring to Ocean, Burlington, and Cumberland Counties, N. J., dated May 14, 1880, says:

The forest fires of this region were estimated as having overran a hundred square miles of arable land, berry bogs, timber land, and vineyards. The little village of Great Republic lost 22 buildings in and about the village, and from this place the fire took a southerly course towards the iron mills and Cedar Lake, and skirting about Hammonton and Ellwood, spread toward Mullicus River on the northeast and Great Egg Harbor River on the southeast. The loss in the vicinity of Atco, Camden County, was estimated at over \$20,000.

Cape May County.—Extensive fires occurred in April and May, occasioned by railroad sparks, clearings, and incendiaries. More than 7,000 acres were probably burned over in Cape May County, with a probable average loss of \$4 to \$5 per acre. Some of it, farther from market, was not worth as much. A portion of it was small timber; some of it had been previously burned over, and some was valuable. From 600 to 800 cords of fire wood-prepared for market, and worth \$2 to \$3 a cord, was burned.—(*George M. Post*, South Seaville, N. J.)

Another account estimates the area burned as 9,000 acres, and the loss at \$90,000, including 400 cords of wood, cranberry marshes, and a school-house.

Destructive fires have occurred in this county as follows: April 16, 1856, April 13, 1871, May 2, 1875, and May 3, 1880. The first of these is said to have been caused by malicious mischief; that of 1871, from the indiscreet burning of old-field sedge, and that of 1875 was proved in court to have been caused by the negligence of railroad employes, and for which the railroad company paid damages.

In all of these fires the wind was from the west and southwest. The chief damage from fires in this region happens from the 1st of April to the last of May. The fast trains are believed to do the most damage, and for these especially the road companies should be required to keep sufficient watchmen to extinguish fires before they begin to do damage.

In *Cumberland County* the area burned over in the spring of 1880 was, according to one account, estimated at 40,000 acres, worth before this casualty not less than \$10 per acre. Its value after the fire would not average more than \$2 per acre, thus showing a total loss of \$320,000 in this county alone.

Another correspondent estimated the area burned over as from 75,000 to 80,000 acres. The first fire was set about 10 miles north of Cape May County line, on the 1st day of May, by a spark from a locomotive. It ran northward some 10 miles to the Cumberland furnace, where it was subdued.

Three weeks afterwards another fire originated about 5 miles south of Salem County and swept through the whole of the Cumberland furnace tract, containing 23,000 acres. It was not subdued until the 1st of June, at which time it had reached the limits of the first fire. The fires were not finally extinguished until about the 10th of June.

The loss of property in this county, otherwise than the woodland and the soil, was not large, being limited to a few cabins and some acres of cranberry bog. One correspondent estimates this loss at about \$5,000. No dwellings of much importance were burned, and no lives were lost. A large amount of prospective value was lost in the destruction of young trees not yet in size for cutting, but at an age when they were gaining in size very fast.

The means chiefly employed for stopping the progress of the fire was by back-firing on the line of the roads; those nearest the fire being first used, and if that failed, the next. In most cases, however, this was a failure, chiefly because all present and assisting were interested in the saving of their own land, without regard to the interests of neighbors or the welfare of the whole. Some would insist that one road should be taken, and others would as strongly insist upon another. In the mean time, before the matter could be settled, the fires had already crossed the road, where a defense could be made, and an opportunity that might have proved valuable was lost.

It is the opinion of the correspondent reporting from this county,

that three-fourths of all the fires in New Jersey originate from railroad locomotives, and that if they were compelled to use sufficient spark extinguishers, much of this damage might be avoided.

Monmouth County.—Asbury Park and Ocean Grove were greatly endangered by a forest fire, May 17th, and finally, by the aid of the fire departments of these places, and by the efforts of the citizens, these summer resorts were saved from conflagration, partly by back-firing, with the wind in their favor. Had not the wind changed, and the back-firing been seasonably begun, the chances would have been very small of saving these two places. Not more than a square mile of pines was burned over, and it is believed that the woods were fired by malicious persons. (*Newspaper account.*)

In speaking of the general ravages of fires in Southern New Jersey, in the spring of 1880, a newspaper account says :

The fires three weeks ago left a space of over 200 square miles bare and black, and during the last ten days the flames have almost wholly covered the spaces of woodland, and farms of which Atco, Wheatland, Centreville, Medford, and Longcoming are the centers. The sea-coast of New Jersey has a belt about 15 miles in breadth, running back from the shore, of scrub-oak and pines growing out of dry white sand, which is usually covered with a dead moss that burns like cotton. After a drought of a few weeks, this forest becomes dry as tinder, and a single spark is enough to start a fearful conflagration. The inhabitants of "the pines," are, as a rule, charcoal burners and poor farmers, who, in the best of times, barely earn a subsistence from their little patches. These are the people who have been left homeless by the fires. Nearer the coast are the fishing villages, and the line of great summer cities, all piles of lumber more or less ornamental, and offering food ready for the flames.

The mere destruction of trees and crops by fire gives us no idea of the actual loss. Cranberry bogs to the value of \$100,000 are destroyed; the young people throughout the whole pine region depend upon picking cranberries and huckleberries for their summer support, the latter crop, as it has been estimated, yielding employment to over 80,000 women and children. The fishing villages and sporting stations along the coast are almost wholly dependent on the game in the marshes, which attracts visitors from the cities in summer. Now the marshes, as well as the woods, are a blackened waste, and dead birds and animals strew the ground by the thousand. It will require twenty years for the growth of trees and vegetation, necessarily slow in that chilled atmosphere, to repair the damage of the last month.

(7.) PENNSYLVANIA.

Adams County.—About 1,000 acres were burned over about the 1st of April, chiefly in Franklin Township. The fires were supposed to have been set by persons wishing to clear the land for pasturage, and three persons were arrested by detectives, but were acquitted by the court. The loss to standing timber was from \$5,000 to \$10,000, besides over 1,000 cords of fire-wood, and a large number of chestnut fence-rails. The county commissioners have offered a reward of \$50 for the arrest and conviction of any persons guilty of setting forest fires. It is believed that a larger reward would be of great service in tending to suppress them.—(*D. J. Forney, Hanover, Pa.*)

Bedford County.—Probably 8,000 acres were burned over in this county, commencing about May 10 and continuing about ten days. On perhaps half of this the injury was limited to the young growth of one or two years, the older timber being but little hurt. The loss may have been \$40,000 to standing timber, besides about \$25,000 in tanner's bark ready for market, \$10,000 in cord-wood for charcoal and fuel, and \$15,000 in chestnut rails and posts for fencing.—(*David C. Long, New Enterprise, Pa.*)

Berks and Schuylkill Counties.—About 3,000 acres were burned about the 11th or 12th of April and early in June, one fire being caused by locomotive sparks and two from charcoal burners. The loss to stand-

ing timber was about \$5,000, and to cord-wood \$250. The fires were finally subdued through the efforts of some twenty or twenty-five men.

Blair County.—No extensive forest fires have occurred within two years in this county, but at that time from 20,000 to 25,000 acres were burned over, nearly all of it young chestnut.—(*A. M. Alliston, Royer, Pa.*)

Cambria County.—About 5,000 acres were burned over in Cambria County through malicious mischief, killing half of the timber and destroying a house, a steam sawmill, and about a thousand cords of wood.

Cameron County.—Very destructive forest fires occurred in this county during the spring of 1880, commencing May 10, and continuing fifteen days. They were set by sparks from locomotives, and fires escaped from clearings, and the losses in Cameron, Elk, Potter, McKean, and Clinton Counties were probably \$1,000,000 to standing timber, and half as much more to forest products prepared, or in course of preparation, for market. A few lumber camps, slides, bridges, &c., were also burned.—(*J. M. Brooks, Sterling Run, Pa.*)

Center County.—No very serious fires were started in this county during the year, but in 1878 thousands of acres were overrun in this region. The only traceable origin was either from malicious intent, or carelessness. Many fires originate through the inadvertence of hunting parties, who, after kindling fires, leave them without putting them out.—(———, Howard, Pa.)

Forest fires come in some cases from squatters burning over the ground to obtain pasturage for cattle, and in others from clearing off of lands and in not using proper precautions in burning the brush. They often select the driest and windiest weather to do so. These courses cannot be remedied except by law. We have no means of extinguishing fires when started.—(*H. R. Curtain, Roland, Pa.*)

Clinton County.—The forests in this county were badly injured by fires during the months of May and June, principally of incendiary origin, although some could be traced to sparks from locomotives. It may be estimated that one-fifth of the timber area of the county has been burned over within the year. Most of the large timber had been removed, and the damage was chiefly among the young growth, the amount of loss being difficult to estimate. The timber lands of the county are all upon the mountains which are unfit for cultivation. The young timber which, if protected, would in time become valuable, is completely destroyed by these fires, and no means are attempted for checking them, except as they endanger buildings or other property. Although the laws are sufficiently stringent against setting fire to woods, there is little or no inquiry made when it has been done, and there have been no convictions or attempts to convict for this crime.—(*W. W. Brown, Cedar Springs, Pa.*)

Cumberland County.—Fires, supposed to be of incendiary origin occurred between the 14th and 26th of May, 1880, extending for 25 miles through Franklin, Adams, and Cumberland Counties, and overrunning about 20,000 acres. They probably did \$30,000 damage to the standing timber, and \$10,000 to forest products prepared for market.—(*C. W. Ahl & Sons, Carlisle, Pa.*)

One of the most destructive fires we have ever had, commenced May 9, and continued three days. The ordinary means were employed, but injuries were occasioned by delays from want of organized effort. The burnt district in Cumberland and Franklin Counties must have been at least 30,000 acres, and the value of timber killed about \$100,000. About two-thirds of this can be utilized. There was a further loss of some \$3,000 in forest products prepared for use, and \$2,000 in buildings and

fences. [These estimates are for a separate district from that above reported by Mr. Ahl, and are in addition to the losses that he mentions.]—(*S. G. Bowman, Mechanicsburg, Pa.*)

Delaware County.—The barrens in Middletown township were burned over with great loss, about May 17. The fire was started by tramps.

Elk County.—About 20,000 acres were burned over in this county from May 15 to June 1, from fires set by careless and mischievous persons, and those escaped from clearings. The burnt lands had mostly been cut over for timber or bark, and, being very dry, it was practically impossible to stop them till the fuel was exhausted. The fire did not prevail extensively in the dense woods, and the loss to standing timber may be estimated at \$5,000. A few cheap buildings were burned.—(*J. C. McAlister, Brandy Camp, Pa.*)

Fayette County.—Fires occurring in the latter part of April, and originating from causes unknown, burned for about three days, until finally controlled by firing along the roads, and thus making them lines of defense. These fires occurred in Spring Hill, Georges, and Wharton Townships, but no statistics can be given as the amount of loss or the extent of territory burned over.—(*R. S. Martin, Fairchance, Pa.*)

Franklin County.—Forest fires began about the 10th of May, on the North Mountain, and continued nearly two weeks, burning over nearly 4,000 acres. The damage was not so great, as the timber is principally the first growth, which the fires will not so readily kill, although it injures the growth. Fires were also raging on the South Mountain with great fury, but as it is expected that an account would be given by others, no further mention is made.—(*C. Burkhart, Chambersburg, Pa.*)

Fulton County.—In April and May fires, supposed to have been set with evil intent, prevailed in this and Franklin Counties. These are estimated to have burned over 1,000 acres, causing a loss of \$500 to standing timber, and probably twice as much to rails and cord-wood.—(*M. Dickson, McConnellsburg, Pa.*)

Huntingdon County.—Fires are most apt to occur in the spring of the year, from the middle of April to the middle of May, being generally set by the farmers to improve the pasturage for cattle, or in September, when the fires are more frequently set by hunters. It might be estimated that 20,000 acres are burned over annually in the four townships of Union, Cass, Todd, and Carbon, in this county. The loss may be \$5,000 to standing timber, and \$1,000 in rock-oak bark.—(*J. A. Patterson, Paradise Furnace, Pa.*)

Fires commencing about the middle of May, and continuing a week, burned over about 30,000 acres within the district reported from. The loss cannot well be estimated, as it sets back the production some five or ten years.

Juniata County.—No considerable fires have occurred during the present year, but such fires are not uncommon in very dry weather. As the county is surrounded by mountains, and as a railroad runs along the foot of some of them, sparks from locomotives occasionally set fires that run through young and valuable groves of chestnut and locust, which are killed. The area thus burned is generally not very great; perhaps half a mile in width by two or three in length. When not extinguished by the rain they are usually stopped by firing against them.—(*Hugh Hamilton, Mexico, Pa.*)

Luzerne County.—Fires occur every year in this region, the loss in Luzerne County being estimated at \$100,000 annually. They generally continue until the rain extinguishes them.—(*S. Jenkins, Wyoming County.*)

Lycoming County.—A fire began about the 1st of April and continued till the middle of May. It was set by locomotives, or from clearings, and is thought to have done injury to the extent of \$10,000 to standing timber, and \$10,000 to logs and bark.—(*D. R. Updegraff*, ———.)

Mercer County.—A fire burned over about 450 acres of low ground, burning in the bog, and undermining large trees, completely clearing the ground. The loss is estimated at \$20 per acre, besides from the burning of saw-logs, stave-bolts and tan-bark.—(*Wm. Gibson*, Jamestown, Pa.)

Mifflin County.—Fires occurred from the middle of May to the 1st of June, burning over from 12 to 15 square miles within the district under observation, although there were other fires in the county of which no facts can be given. They were caused by malicious firing, or by hunters to kill down the underbrush. The damage to standing timber may be estimated at \$10,000, besides 3,000 cords of wood cut for coaling.—(*R. & Lee*, Lewiston, Pa.)

Monroe County.—In this and Carbon Counties probably 20 per cent. of the standing forest was burned over in the spring months. The damage to standing and other timber must amount to millions of dollars. Much of this timber was of from ten to twenty years' growth.—(*Abel Storm*, Brodheadsville, Pa.)

Montour County.—Not much damage has been done the present year in this county, perhaps 30 acres having been burned over.—(*C. E. York*, Danville, Pa.)

Perry County.—Fires occurred in May from clearings, and spread over portions of this county and Cumberland, on the mountains that lie on the county lines. The losses are not known. About 100 tons of bark were burned.—(*D. H. Sheibly*, Landisburgh, Pa.)

Pike County.—Extensive fires occurred in the month of April, 1880, in this county. A newspaper account dated March 19 reports extensive forest fires in that region and the loss of over 3,000,000 feet of lumber, besides a vast amount of valuable timber. Several houses and barns had been burned. During the last days of August, 1876, a forest fire swept through the mountainous region of Pike and Wayne Counties, in the northeastern corner of the State, destroying property of great value in the form of timber, buildings, hay &c., and great quantities of bark got out for the tanneries.

Schuylkill County.—Forest fires did considerable damage in this county at various times from the middle of April to October.—(*E. Hummel*, Pine Grove Furnace, Pa.)

Sullivan County.—Fires occurred in this county during about two weeks in the spring, and from four to six weeks in the fall. They burned over some 5,000 acres in this county and extended into adjoining counties on the north, southeast, and southwest, causing damages estimated at \$30,000 to standing timber, \$6,000 to hemlock bark, \$4,000 to saw-logs, \$3,000 to fences, and \$1,000 to crops.—(*R. Bedford*, Campbellsville, Pa.)

Tioga County.—Fires occurred in May, from the 5th to the 20th, burning over, as estimated, 15,000 acres, with a loss of \$20,000 to standing timber, \$15,000 to other forest products, and \$5,000 to buildings, &c.—(*M. B. Butsman*, Tioga, Pa.)

Union County.—Fires occurred to unusual extent in May, continuing two or three weeks, and burning over about 50,000 acres in this and adjoining counties to the south and west. The losses were greater than in any previous year, being estimated at \$100,000 to standing timber and

\$5,000 to forest products prepared for market.—(*J. A. Grundy*, Lewisburg, Pa.)

Warren County.—A few small fires occurred in May, burning over in all some 700 acres, from which most of the valuable timber had been removed. The loss is estimated at \$2 per acre, besides other losses of \$500.—(*F. R. Miller*, Sugar Grove, Pa.)

Wayne County.—Forest fires in the spring of 1880 did extensive damages. Many thousand acres were burned, and one man lost a million and a half of lumber in logs ready for rafting.—(*C. W. Hamlin*, Bethany, Pa.)

The correspondents in Armstrong, Beaver, Blair, Butler, Columbia, Crawford, Erie, Hunterdon, Lancaster, Lehigh, McKean, Mercer, Northampton, Potter, Summit, Venango, Warren, Westmoreland, and York Counties reported no forest fires of importance during the year in their several counties.

(8.) MARYLAND.

Alleghany County.—About 10,000 acres were burnt over in the western part of this county about the middle of April from fires set by locomotive sparks and carelessness. They were arrested by firing along roads and ravines with great success. The remedies against these fires should be more vigilance on the part of railroad employes and individuals and a severe law against starting them.—(*James W. Wilson*, Rawlings Station, Md.)

Cecil County.—About 300 acres were burned over in April and May by fires set, as was supposed, in three instances by locomotives, and in one case from a coalpit. The loss to standing timber was about \$1,500 or \$2,000, and to cord-wood (300 cords) about \$600.—(*George P. Whitaker*, Principio Furnace, Md.)

Frederick County.—Fires were set by incendiaries about the 1st of May, and continued four or five days, burning over about 3,000 acres, mostly of young growth, which was killed. The ground had been cut over in 1875-'76, and the new growth, mostly chestnut, was about 12 feet high. The damage was therefore prospective, as the timber in twenty-five years would have made at least 2,500 rails per acre. Some 400 cords of wood for coaling were also burned.—(*I. B. Kunkel*, Catoc-ton Furnaces, Md.)

Somerset County.—No destructive fires have occurred in this county during the year 1880, but quite destructive ones have happened in former years.—(*L. L. Waters*, Princess Anne, Md.)

Washington County.—Fires occurred in this county October 25, 1879, and continued five days, burning over about 1,500 acres, and doing damage to the amount of \$1,000 to the timber and \$100 to other property.

Wicomico County.—About 300 acres were burned at various times from April to August, mostly originated in sparks from locomotives and from carelessness. The loss to timber was about \$5,000, and to forest products prepared for market perhaps \$500 more, besides \$300 worth of fences. The woodlands in this county are now so thin that fires seldom do much damage, and the present year has shown more loss from this cause than in any single year for a long time before. This was probably due to the extreme drought of the season.—(*E. S. Tradwin*, Salisbury, Md.)

In the counties of Baltimore, Carroll, Dorchester, Prince George, Queen Anne, Somerset, and Worcester there were no fires of noticeable extent in the year 1880.

(9.) VIRGINIA.

Alleghany County.—Fires occurred in the mountains of this county in April and May, chiefly in a young growth of timber. Perhaps a tenth part of the woodlands in this county are burned over annually.—(A. A. McAllister, Covington, Va.)

Amelia County.—Fires occurred from early in March till late in summer, and fires could be seen most of the time in two or three directions in this and neighboring counties. The loss must have been very great, perhaps half a million of dollars, in forest products. Attempts have been made to prosecute persons for setting fires in the woods, but it has not been found possible to prove "wilful intent," and witnesses have been readily found to aid in the defense. The damages appear to have been increased in recent years, and appears largely due to negroes.—(Dr. R. Wood, Rodophill, Va.)

Amherst County.—Serious fires have not occurred. A square mile or two may have been overrun, but not with much loss, except to cordwood and fences. Five or six years ago a fire prevailed on a ridge some 10 or 12 miles long and 1 or 2 broad, which destroyed much timber, but did little other damage.—(M. H. Garland, Harris Creek, Va.)

Bedford County.—A very destructive fire occurred some five years ago, near Staunton River, in this county, extending about 15 miles in length and from 3 to 4 in breadth. The timber along this extent was nearly all destroyed, except the pine, and some loss of life occurred.

Bland County.—Fires occurred in April upon the mountains, as they do nearly every year, being often set to improve the pasturage for cattle. The damage was not great. This remark applies much the same to Bland, Giles, Smythe, Tazewell, and Wythe Counties. The fires generally burn until they are extinguished by the flames.—(I. M. Hicks, Bland Court-House, Va.)

Botetourt County.—Most of the woodlands in this county lie on the mountains, which are often burned over, generally in April or November, the fires continuing several days. They often originate from carelessness of farmers in the clearing of their lands, and sometimes intentionally, by being kindled by those interested in the ranging of cattle. In an area of 20 miles square probably 5,000 acres of mountain lands are burned annually. Their destruction is mostly limited to the young and tender trees, and may amount to \$10,000 a year in standing timber, and half as much in fences.—(I. G. Speiry, Amsterdam, Va.)

Carroll County.—As to fires, they originate generally in the spring-time from carelessness both in coaling-grounds and in new clearings. The damage in this region is generally not great, being limited to a few cords of wood and a few lengths of fence.—(E. F. Osborn, Sylvatus, Va.)

Chesterfield County.—Fires occurred from time to time in this county from about the 10th of April to the 1st of July, 1880, originating from the sparks of steam saw-mills or locomotives, or from the clearing of land. The area burned in Chesterfield, Dinwiddie, Hanover, Henrico, and Charles City Counties must have been 10,000 acres, killing most of the small growth and half of the large timber. The value of property destroyed cannot be determined. In 1857 or 1858 a fire at or near the Richmond and Petersburg Railroad, in an hour's time, had crossed the James River, a distance of four miles, destroying all the perishable property in its way, in one instance being blown 300 yards across a field and burning several houses.—(Wm. B. Chalkley, Chesterfield, Va.)

Clarke County.—Some fires occurred on the Blue Ridge in May, burn-

ing over a considerable area of land but the timber was sparse and not valuable.—(*P. H. Powers*, Berryville, Va.)

Craig County.—Fires occurred in February, March, and April, burning over a large area of mountain land and killing a considerable amount of timber.—(*Z. T. Kale*, Newcastle, Va.)

Essex County.—Fires occurred in July, continuing ten or twelve days, and burning over at least 5,000 acres in this and King and Queen Counties, with a loss of five to six thousand dollars and \$2,500 in forest products prepared for market. Two saw-mills and much of the fencing were destroyed.—(*A. T. Hoskins*, Miller's, Va.)

Fairfax County.—Perhaps 2,000 acres were burned over in March, not greatly injuring the large timber, but destroying the smaller growth and some \$2,000 worth of cord-wood and timber, besides perhaps \$500 worth of fencing.—(*B. Canfield*, Fairfax C. H., Va.)

Hanover County.—About 3,000 acres were burned from the middle of February to the middle of April in this county, not all in one body, but in different parts. The loss to standing timber may have been \$2,000, to forest products prepared, \$500, and to fences, \$1,500.—(*W. H. Campbell*, Negro Foot, Va.)

James City County.—The most destructive fires that have been known for years occurred in March, April, and May in this county, being mostly started from carelessness in the burning of brush, and by sparks from saw-mills. The damage was mostly done to small undergrowth, and is hard to estimate. Some 200 cords of wood and a quantity of fencing plank, &c., were destroyed. These fires occur almost every spring generally from carelessness, or from the clearing up of lands, or the burning off of marshes to prevent them from sinking and yielding too much.—(*J. H. Allen*, Burnt Ordinary, Va.)

King George County.—Fires occur more or less every year, generally in April, in preparing the ground for corn. The forests of the county are being cleared off by eastern men, and carelessness in the use of fire, is one of the principal causes of these fires. The loss to timber may be \$1,000 a year, and to cord-wood as much more.—(*C. Mason*, Edge Hill, Va.)

King and Queen County.—Fires occurred in this and King William's County in April, burning over two miles square, and scorching a large quantity of cord-wood. A large fire occurred across the river Mattaponi, which extended some 18 miles, and burned several buildings. It destroyed much valuable timber, and raged for over a week. "The burning of houses and timber is much more frequent now with us than heretofore, owing in a great measure to the insurance of houses and the cord-wood in the woods."—(*Wm. D. Gresham*, Montopike, Va.)

Lancaster County.—Several fires occurred in March and April, 1880, each continuing two or three days. They mostly were set from the clearing of land, and one from an explosion of gunpowder used in splitting large logs. The area burned over was from 500 to 1,000 acres, and the loss may be estimated at \$500 for standing timber and \$1,000 for cord-wood, fences &c.—(*Hon. Samuel Downing*, Lancaster Court-House, Va.)

Middlesex County.—Forest fires, from clearing land, occurred about March 1, and continued several weeks. They spread over 10 square miles, and are estimated to have injured standing timber to the value of \$5,000. These forest fires quite often are kindled from clearings, and the use of fire in the fields from the 1st of March till September should be forbidden by law.—(———, Urbana, Va.)

Montgomery County.—Fires often occur in the spring and late in the

fall, from causes seldom known. They usually occur on the mountains, where the soil is unfit for cultivation, and are of annual occurrence, destroying timber of considerable value.—(*John M. Thomas, Blacksburg, Va.*)

New Kent County.—Fires occurred in April, and continued five or six weeks, mostly from burning brush in the clearing of lands, or from the carelessness of smokers, or sparks from locomotives. From 3,000 to 4,000 acres were overrun, doing damage to the standing timber to the amount of some \$2,000, with as much more to buildings and fences, and twice as much to forest products prepared for market.—(*W. N. Tinsley, Tunstalle, Va.*)

Powhatan County.—The dangerous period is between the middle of February and the 1st of May. Although the county has escaped the present year, it sometimes suffers. Perhaps a law might be enforced making it a misdemeanor for persons setting fires for clearings, &c., within the above period.—(*W. W. Michaux, Michaux Ferry, Va.*)

Princess Anne County.—Fires occurred in February and from time to time though the spring and summer, burning over at least 3,000 acres in this county. It is impossible to tell the damage by fire, as most of the timber was prostrated by a cyclone on the 18th of August, 1879. The greatest injury was done to the young timber.

Richmond County.—Fires occurred about the 1st of May, and continued three days, extending over an area of about two miles square, along Toluskey Creek, in the lower part of the county. As the wind was high and no aid at hand, the fires continued till there was nothing more to burn. Besides about \$1,000 lost in standing timber, there was twice as much more in forest products prepared for market, fencing, &c.—(*Dr. R. A. Bufield, Farmer's Fork, Va.*)

Rockbridge County.—Fires, burning from about March 15 to May 20, spread over some 25,000 acres in different parts of the county, doing damages that cannot well be estimated to the young growth of chestnut, red oak, and water oak, that form the principal growth of the burnt district. "An observation is made by the old residents that fires, extending over a large area, occur at an average interval of seven years."—(*C. A. Brady, Buffalo Forge, Va.*)

Shenandoah County.—Fires have not occurred to much extent the present year in this district, but have formerly happened, generally in the spring. "Ninety-five per cent. of the fires in the woods are caused by persons who want to range cattle in the mountains. We need strict laws for punishing severely parties who fire the woods."—(*W. Milner, jr., Shenandoah, Va.*)

Fires, supposed to have been set for the improvement of pasture, for cattle, spread for miles along the western border of this county, and the eastern part of Hardy County, West Virginia. The loss was large but cannot be stated.—(*Wissler, Armstrong & Stone, Liberty Furnace, Va.*)

Every few years our large mountains are fired, I think, by parties who put cattle into pasture, or by persons hired by them. Penalties against setting fires do not amount to much, as persons can hardly ever be caught at it. If we could have a law for *taxing every county so much per acre burnt, not paying anything to any one owning the land for damages.* The sheriff and his assistants ought to be required to extinguish fires in their districts, with power to call upon every one for help who is liable to road-work. Heavy penalties should be imposed upon those who refuse to help, and only a small allowance made for those who assist.—(*Jacob Crisler, Liberty Furnace, Va.*)

A fire, starting from coal-pits, occurred on the 12th of May, and ex-

tended about 4 miles. They burned same 3,000 cords of wood, besides other damages that cannot be easily estimated. Many fires are set in this region in the spring for cattle-grazing.

Smythe County.—About 40 acres were burned over May 7, 8, 9, 1880, from fires carelessly allowed to set from coal-pits. The loss to timber was about \$800.

Tazewell County.—Fires began about April 1, and continued three or four days. They were set in burning off brush and logs, in preparing the ground for corn, and may have run over a thousand acres, doing no great damage.—(*J. M. McCall*, Tazewell Court-House, Va.)

Warren County.—Fires, burning over some 200 acres, occurred, chiefly injuring the young growth. About \$200 worth of tan-bark, cord-wood, ties, rails, and fences were destroyed.—(*Tho. W. Timberlake*, Millsdale, Va.)

Wythe and Grayson Counties.—One or two thousand acres were burned over in these counties in the latter part of March and early in April, destroying \$2,000 to \$5,000 worth of timber and \$500 to \$1,000 worth of cord-wood, besides \$1,000 worth of buildings and fences.—(*J. W. Robinson*, Johnson Forge, Va.)

THE DISMAL SWAMP.

In an account of the physical and geological characteristics of the Great Dismal Swamp and the eastern counties of Virginia, by Prof. N. B. Webster (*Am. Naturalist*, IX, 260), the opinion is also expressed that Lake Drummond was formed by fires. The lake is about 40 miles long by 15 to 20 miles wide, and 15 feet deep in the middle, with a bottom of swamp mud, covered in some places with white sand. The lake is 21 feet higher than mean tide, and the swamp itself gently slopes toward the east. Extensive fires are common in dry seasons, burning not only the vegetation above the surface, but the soil itself, which is almost entirely composed of organic matter, is burned into holes and depressions sometimes 2 or 3 feet. In attributing the origin of the lake to fires Prof. Webster does not suppose that the bed of the lake was ever burned to the depth of fifteen feet, but that at some remote period the large area of its bed was burned so low that the water from succeeding rains filled it so deep that no vegetation would grow, and that each succeeding year has added to the general height of the region around it by the annual deposit of decaying vegetable matter, and that thus its depth has been increased by additions to the banks above, instead of by excavations. The perpendicular banks and the charred remains of stumps that have been found at the bottom appear to confirm this theory. It seems probable that the Dismal Swamp was formerly more extensive than at present. The trees of past centuries, buried in the swamp, as well as the present growth, afford valuable material for shingles, staves, and other uses where great durability is desired.

(10.) NORTH CAROLINA.

Beaufort County.—This section is annually visited with forest fires that do much damage. They usually occur in March, April, and May, and continue from one to ten days. They occur when the leaves and trash on the ground are very dry, and from railroads or the careless use of fire. Several thousand acres of pine lands were burned over in March and April, 1880, in this county, but there are no means of knowing the amount of damage done. In *very dry* weather our best swamp

lands will burn, and when once on fire it is almost impossible to stop the fire until a rain comes. Lake Mattamuske, in the adjoining county of Hyde, was formed in the bed of a great fire before the first settlement of this county. It is 20 miles long and from 4 to 6 wide, and is yet full of half-burnt cypress and juniper logs.—(*R. W. Wharton*, Washington, N. C.)

Columbus County.—We have had no fires this year, but live in continual dread of it in our turpentine forests. Happily, we have had no fire for several years, as they have been kept off for twenty years. From most of the forest land there has sprung up a new growth with the pine, consisting of several species of oak, dogwood, gum, &c. If a fire breaks out every one hastens to it, and by means of roads, swamps, &c., soon stop it. Much care is taken by the people to prevent its getting out. An extensive fire would seriously injure our county.—(*W. M. Baldwin*, Whiteville, N. C.)

Cumberland County.—Some fires of small extent have occurred, usually from the carelessness of persons in burning off new ground to plant. Nine-tenths of the fires that occur in this county are caused by careless hunters, by coon-hunting at night, &c.—(*J. Evans*, Idaho, N. C.)

Duplin County.—Fires occurred in March and June, doing damages to the value of \$1,500 or \$2,000 to the timber and \$1,000 to turpentine and tar-kilns, besides as much more to fences. A turpentine orchard, once burned, is never worth more than a tenth a part as much as before. Great damages from fires occurred in 1865, at the time of a military raid, being set to drive out the horses concealed in the woods. Lands that were worth \$1,000 annually for turpentine and timber, have not since been worth more than \$100.—(*E. D. Pearsall*, Kenansville, N. C.)

Edgecombe County.—No very destructive fires have occurred within the year. In 1855 we had an extensive forest fire that spread over eight or ten thousand acres and killed a large crop of pine timber.—(*J. M. Mayo*.)

Mitchell County.—Fires occurred in March, doing much damage, but the amount cannot be estimated. They were set by malicious persons, and others in search of mica. Probably 20 per cent. of the surface of the county is now a barren waste from fire.—(*S. W. Blalock*, Penland, N. C.)

Montgomery County.—We have periodical fires in spring, generally in April, that are set to improve the pasturage. The area thus burned was in two sections, and embraced about 10 miles square.—(*C. C. Wade*, Troy, N. C.)

New Hanover County.—No very destructive fires have occurred within the year. They generally occur in March, and are set for the purpose of improving the grazing. These fires are common in the turpentine region of the State, and sometimes do great damage to turpentine forests. The trees are often raked around to protect them from fire. A considerable loss to this interest occurs annually from these fires, as also in the destruction of fences and the undergrowth, especially young pines.—(*A. R. Black*, New Hanover, N. C.)

Pasquotank County.—Several thousand acres of the Dismal Swamp in Princess Anne County, Virginia, and in Columbus, Gates, Currituck, and Pasquotank Counties, North Carolina, were burned in May, 1880. The fire continued about two weeks, and was started by the accidental dropping of fire by night hunters. Many thousand dollars' worth of growing juniper timber were destroyed, besides large quantities of railroad-ties, fence-rails, posts, &c. There appears to be no mode of preventing or limiting these fires that occur every dry season. Careless-

ness cannot be prevented, and water cannot be had for extinguishing the flames. Many thousand dollars' worth of timber are destroyed annually in this region.—(*G. W. Pool*, Elizabeth City, N. C.)

Pender County.—Ten miles of land were burned from March 1 to May, in various parts of the county from fires set in clearing up lands. Turpentine trees occur all over the county, and when a fire gets started great damages are done to the pine forests. People that own stock, but no land, will sometimes, in order to have burnt woods for their cattle set these fires. When our turpentine trees wear out (which will be in a few years), we shall have better farms and less fires. The turpentine business is ruining all the pine in Eastern North Carolina.—(*Daniel Shaw*, Rocky Point, N. C.)

Perquimans County.—A fire occurred in the early part of July, during a dry spell, in the Dismal Swamp, which is common to this county, Pasquotank, Gates, Camden, and a part of Virginia, extending some 40 miles in one direction and from 10 to 30 in another. A part of this track is high pine land; other parts have deep, spongy soil, with juniper and cypress growth. In other parts there is a deep, black mud or *slush*, with a bottom somewhere from 10 to 30 feet deep. When fires get into this swamp, which has an undergrowth of reeds from 6 to 12 feet high, and so dense that a man might be within 5 feet of you without your knowing it, they will burn down to the water, or subsoil of clay. Lake Drummond was undoubtedly made this way, and is 15 miles long by 3 or more miles wide.—(*Wm. Nixon*, Winfall, N. C.)

Robeson County.—Fires occurred in March and October, through carelessness, and burned about four days, doing damage estimated at \$2,000. These fires are often caused by torch-lights of persons going from house to house, or hunting with torches in the night. Perhaps they might be prevented by making this an indictable offense.—(*J. B. McCallum*, Red Banks, N. C.)

Wayne County.—No fires of importance have occurred in this region since 1849, when a great destruction of pine and other timber occurred in Cumberland, Sampson, and Duplin Counties. The measures for preventing fires adopted here are the careful raking around the forest boundaries of all dead leaves, and then burning them under the eye of vigilant watchers. These firings are performed in March, and the farmers turn out with all hands and see to the careful management of the operation.—(*John Robinson*, Goldsboro', N. C.)

In Alamance, Alexander, Burke, Caswell, Catawba, Cherokee, Columbus, Edgecombe, Franklin, Gaston, Greene, Guilford, Halifax, Henderson, Jackson, Lincoln, Madison, Mecklenburgh, Pamlico, Randolph, Rowan, Salisbury, Transylvania, Warren, Wayne, and Wilkes Counties no important fires had occurred during the year 1880.

(11.) SOUTH CAROLINA.

Greenville County.—A few years ago a fire broke out on the west side of our county, and swept several miles towards the east, doing no damage except to the forest and to fences. Fires are not frequent or generally disastrous here, as some road or stream stops them before they proceed very far. We have the stock law now, and therefore have not fences to burn.—(*M. C. Donaldson*, Greenville, S. C.)

Spartanburgh County.—No very destructive fires have occurred within the year. They generally happen in November from opossum hunters, and in March and April from the burning off of brush in the fields. The latter are generally of greater area. Perhaps 2,000 acres of forest

land were burned over, at a loss of \$3,000 to the timber and \$2,000 to fences. In former days much of our woodland was burned by persons desiring a thousand acres of pasturage for two or three cattle, worth about \$6.25 a head. Hundreds of acres of our land have been burned for this purpose. This has measurably ceased, and will soon end entirely, as our stock law goes into operation on the 1st of January next. Much of our thin forest land has been kept poor by these repeated burnings in former years. Now we have no great complaint to make, and we hope that hunters and careless people may be restrained by the terrors of the law.—(*Charles Petty*, Spartanburgh, S. C.)

No forest fires of much extent occurred in Anderson, Chester, Greenville, Laurens, Newbury, Oconee, Swain, or Union Counties during the year.

(12.) GEORGIA.

Jefferson County.—No destructive fires have occurred in this section. It is true we have forest fires, generally, every winter, which are set on purpose, and for two reasons. The operation is called by all classes "burning the woods," and is practiced as a *safeguard against destructive forest fires*. The accumulation of combustible materials in one year is not enough to create a destructive or seldom a dangerous fire. Farmers generally let each other know when they are going to put out fire, and each one fires around his own premises and lets it go; we seldom hear of even a panel of fence being burnt. We have here thousands of acres with nothing to be seen but *pine trees* and *wire-grass*, the latter, all summer, as green as an oat-field, and affording an unlimited and luxuriant pasturage for cattle, sheep, and goats. Frost kills the grass, and by buring off the old sedge in the winter it comes up again in the spring as regular and green as a wheat-field, with no shrubbery or undergrowth to obstruct the view as far as the eye can reach. To secure this inestimable range for stock is the second object in "burning the woods." It is the accumulation of *years* that creates these destructive forest fires. Were they burnt off regularly every winter or early in the spring there would seldom be any trouble in controlling the fires. Whether the annual burning is injurious or not to the land is a debatable question.—(*Dr. J. B. Randall*, Wadley, Ga.)

Returns from thirty-two other correspondents in Georgia concur in the statement that forest fires are not often very destructive in the northern and middle portions of the State, and that they are very frequently set on purpose to improve the pasturage of the mountains. The custom is thus described by one correspondent:

About the 1st of May they take their stock, cattle, horses, and mules, to the mountains, 10 or 15 miles from any settlement, and go to carry salt for them every two or three weeks. They allow them to remain till frost comes; that kills the vegetation, and then they bring them in. They generally become very fat by the time that frost comes.

The same writer, in describing the southern portion of the State, says:

Down in the lower part of the State, in the long-leaf pine and wire-grass fires frequently do much damage, and, if they get well started, it is very difficult to stop them till they reach a water-course or swamp lands that are too wet to burn. If fire happens to get into these forests it very often destroys them for turpentine, and it often kills the trees entirely. There is but little chance to stop the fire, if everything is dry, until it gets to a water-course or a swamp too wet to burn. Where they are dipping turpentine they generally keep these trees raked around and burned off clean, to prevent fire from getting in.

Polk County.—Forest fires are caused by hunters firing the woods, farmers burning off new land, teamsters throwing fire out of their wag-

ons into the woods, and the carelessness of colliers in drawing coal. We try to prevent fires from the latter cause by having the coalings as near each other as possible, so that they will keep the adjacent woods raked and clean of leaves as possible, and in hauling, divide it up and cut it off by roads. In case of fire we can then summon a larger number of men to extinguish it; besides, we hold every man strictly to account for his carelessness.—(*J. E. Stillwell*, Prior Station, Ga.)

(13.) FLORIDA.

Calhoun County.—Fires, beginning in February, and starting from the camps of hunters and from lightning, ran over about 100 square miles in this and Washington Counties, destroying very little standing timber and a few hundred dollars' worth of fences. By a state law, parties, by giving notice to neighbors, are permitted to "burn the woods" at specified times, so that new grass may spring up for stock. Cattle and sheep are kept almost exclusively on the grass of the pine woods. The destruction of fences was greater this year than usual.—(*J. W. Keyes*, Calhoun County, Fla.)

Dade County.—Frequent fires occurred at intervals in this county from November to June, having been generally set by Seminole Indians or worthless whites. They were mostly allowed to burn, unless endangering houses, when they were stopped by back-firing or whipping out. These forest fires existed almost every day at some point in the pine woods during the season above mentioned. They did but little injury to the large timber, but all young trees are generally killed.—(*Dr. R. B. Potter*, Miami, Fla.)

Gadsden County.—Fires occurred in March from the careless firing of the woods for the purpose of improving the quality of the grass for cattle. The forests are quite generally burned over in nearly every county of the State, under the false idea that it is better for the range of cattle. This firing is done in the month of March, and very often when it is dry and the wind quite strong. The injury to the standing timber may be estimated at about 10 per cent., and more or less of fencing is burned every year; sometimes a considerable portion. The remedy appears to be in the enactment of a State law severely punishing persons who fire the forests regardless of whom the fire may run over. If we had such a law, and if people would keep their fences well cleared around, there would be but little danger and the lands would improve every year quite as much as they are now injured. As it is, the land is kept impoverished by these continual burnings and the timber is materially injured.—(*Jesse Wood*, Mount Pleasant, Fla.)

Hernando County.—The forests are set on fire by the stockmen in early spring, and they spread over the uninhabited portion of the country until stopped by rains or by water-courses. There are large areas of territory in this State deprived of any green timber, but with a great deal of dead timber, which has evidently been dead many years anterior to the coming of the white man. The Indians say that the fire killed the timber in these places, some of which are probably 10 miles square. This dead timber is principally pitch-pine, and yields an abundance of tar. It is used for building houses and fences.—(*Dr. S. Stringer*, Brooksville, Fla.)

Hillsborough County.—After noticing the annual fires set by stock-owners, which burn over most of the woods every year, the correspondent says:

It is argued by many that it does no harm to timber to be burned over, and others say that it is necessary to kill out snakes, ticks, &c. The law forbids fires previous

to February, but large districts are burned over before that. If the fires are kept off until February the grass comes up quickly and makes good pasturage, unless it happens to be a dry time. We have very little undergrowth timber on account of fires.—(*W. F. White, Dunedin, Fla.*)

Levy County.—Fires ran over about one township in Levy County during the middle of March, 1880, killing the young timber, but doing but little damage to the older growth. There appears to be no way of stopping the practice of firing the woods but stringent laws.—(*Geo. H. Ambrose, Bronson, Fla.*)

Putnam County.—Fires occurred in March and continued two or three weeks, running through most of the wild lands in this part of the State, in Marion, Putnam, Clay, Bradford, and Alachua Counties. It is difficult to estimate the damage which these fires do annually. I think 5 per cent. would be a very low estimate of the injury done to standing timber, and perhaps 6 or 8 per cent. would not cover the damage. Besides this, there was considerable loss from the burning of fences and a few buildings.

As the law permits the burning of leaves and grass in spring, I know of no remedy, except to educate the people so that they may understand that it does not improve, but that it will finally destroy the range, by burning the leaves and grass, besides gradually destroying the country. In my section now it is a hard matter to find a sound tree fit for lumber on any part of the wild lands, owing to the annual fires, that burn up the mulch of leaves and grass. The land is impoverished, and the trees are diseased and dying for want of proper nourishment. As the lands belong mostly to the United States, or to the State, every one thinks it none of his business to look after it, and a great majority of the squatters are ignorant of the damages they are doing, perhaps not willfully or maliciously. This has been going on for thirty or forty years, and in a few years more there will be no timber left. I traveled over a great portion of the State, and the above account will apply to all the wild lands. In what is called the "flat-woods," the damage is not so readily noticed, but it is ever damaging to forests anywhere to burn them over annually.—(*Amos L. Griffith, Putnam Hall, Fla.*)

Returns from Brevard, Clay, Hamilton, Lafayette, Santa Rosa, Sumter, Suwanee, Taylor, and Washington Counties all concur in describing the annual burning of the woods in the early spring months, and generally express the opinion that the lands are gradually suffering an injury from this cause. They admit that the vegetable mould is burned, and that the crop of grass, which the practice is intended to encourage, is gradually becoming less. Whenever the fires get into the turpentine woods they burn into the boxes, causing the trees to break off in the first severe wind, thus doing great damage to the timber all over the region where the turpentine is obtained.

(14.) ALABAMA.

Calhoun and Talladega Counties.—The inhabitants have in past years fired the woods in the fall and winter for the purpose of keeping down the bushes so as to have a good cattle range, but we have had a State law prohibiting the firing after the 1st of March, until fall. We have extensive iron foundries in these counties, and since these went into operation there has been but little firing, from the fact that it would endanger much cord-wood as well as fences. I think it would be well to have a stringent State law, prohibiting entirely the burning of woods, as the country is becoming densely populated, and much damage might

ensue by the burning of fences and cord-wood, as well as the killing out of the small growth. The woods had been kept burned by the Indians so that there was nothing but large timber when the whites came in. The burning has been left off gradually, until now it is a rare thing except in the mountains.—(Dr. S. C. Williams, Oxford, Ala.)

Calhoun County.—In answer to the question as to the usual time of beginning and continuance of fires, it is said:

They begin in the spring and continue two or three months, and also at intervals in the summer and fall.

As to their origin it is said:

Small farmers and others, having a few lean cattle, set fire to the dried grass-weed and leaves in the spring, and burn off to get a fresh growth of wild grass for their cattle straying in the woods. They destroy all the young undergrowth, much of the virgin forest, and all trees in pine forests that have been hacked so that the turpentine flows. In arresting these fires, parties rake back a strip of leaves when they can, or fire against the fire, going ahead of the fires and starting new ones, letting them burn towards the approaching fire, and whipping out the fire they start after it has burnt a little between them and the approaching fire.

These fires spread over this and the adjoining county every year. Sometimes heavy rains put them out, but fully half of the timber lands are burned over every year. Where the fires are kept off, the growth of timber is very rapid, and the leaves soon form a thick carpet of vegetable soil. Timber is well worth \$3 per acre, and it may be estimated that the damage to forests is fully one-fourth of this sum every year, from the fires going through it. There are no data for estimating the damage done to other property, which is burned every year more or less, but not to any great value or extent.

As for preventive measures it is said:

We need legislation that will prevent any person from firing the woods at any time. The growth of timber (undergrowth and second growth) is very rapid, but the spring fires destroy all roots and vegetable matter in the soil, thus keeping the land for years a barren waste, except for weeds and wild brown ledge grasses. This is particularly so where forests have been cut off for charcoal for iron-works, timber for saw-mills and railroad ties.—(*Woodstock Iron Company, Annistown, Ala.*)

In a paper by Mr. Samuel Noble, of Annistown, read before the United States Association of the Charcoal Iron Workers, at Harrisburg, October 21, 1880, the effects of forest fires is more fully described:

Without some special legislation, it will be impossible to preserve the timber lands from becoming barren wastes, affecting climate, soil, the water courses and springs, and the health of the whole country. The woods are fired indiscriminately every spring, and at all sorts of odd times during the summer and fall, utterly destroying the young undergrowth, and where the timber has been cut off creating a barren waste, leaving the ground exposed to the sun and winds, destroying all vegetation above and below the surface. Under such conditions the rains are quickly evaporated; there is no moist soil or roots or grasses to hold it together. Heavy showers wash away the light soil that should nourish the falling mast which fails to take root. Hundreds of acres near our works, cut off in 1863-'64, that were burnt off several succeeding years, are now barren of everything but a few small black-jack oaks, while lands cut off four years ago, from which fires are excluded, have a second growth of young trees, three to six inches in diameter, and so dense that it is impossible to ride through it.

After cutting off our yellow pine lands, the second growth is generally oak, hickory, and black-jack, all of which is very much slower growth, and less valuable for coaling and lumber purposes than the yellow pine. I think this could be overcome, and the old waste and worn-out fields quickly timbered by gathering the pine mast and seeding the ground. This should be done in the fall by planting the mast five or six feet apart. A man or a boy could go over the ground with a light stick, with a short wide blade in the end, like the point of a wide dirk, and make a small hole, drop a seed in the soil thus loosened, and cover it with his foot, say half an inch deep. They would soon take root, and if the fires were kept off would, in twenty years, produce more timber than the original forest. The cost of planting would not exceed \$1 per acre. (*Journal of United States Association of Charcoal Iron Workers*, ii, 35.)

Shelby County.—No extensive fires have occurred any where in this State, so far as known or heard of by the undersigned. Extensive for-

ests of timber, known as the long-leaf yellow or hard pine, and very resinous, exist in various portions of this region, and other parts of Alabama. Fires in these pine forests are very frequent during the winter and early portions of the spring, and while consuming the wild grass and pine straw with which the surface is frequently covered, in many places thickly, and while destroying the small undergrowth, the standing trees receive little or no injury from the fires, unless a tree here and there, which has been cut into for the extraction of turpentine. Occasionally a tree of this description takes fire and is burned down, but this is a rare occurrence. But little damage is usually done to the large timber, excepting where it has been cut down and left in the forest, when, having become seasoned, it is burned. There is occasionally some injury to the exposed fences of careless owners. The above observations in relation to forest fires, are applicable to all the Southern States, so far as the knowledge and information of the writer extends. It has always appeared to him rather strange and unaccountable that the dense forests of resinous pines of the Southern States, should be uninjured by these periodical fires, on seeing accounts of the destruction by fires, of extensive forests in the North and Northwest.—(*J. W. Lapsley, Shelby County, Ala.*)

Tallageda County.—We have large fires in our forests. They usually occur in the spring, and sometimes continue several weeks, being most frequently set, to burn off old stuff, so that better will spring up for stock. The only means used to arrest them, is to fire against the fire, and in a still time. If the wind is up, they could not be arrested. The damage to timber by these is very great, but cannot well be estimated. Much cord-wood prepared for the iron works is annually burned, but not much other property excepting fences. There can be no remedy suggested, unless, perhaps, stringent laws, making it punishable by fine and imprisonment for setting fire, and by further making the offenders pay for all damages done.—(*Stephen S. Glidden, Alabama Furnace, Ala.*)

Returns from Bibb, Chambers, Cherokee, Cleburne, De Kalb, Franklin, Greene, Hale, Randolph and Shelby Counties, agree in reporting no destructive fires, and nearly all of them confirm the statements above given respecting the practice of firing the woods, for the purpose of improving the pasturage for stock.

(15.) MISSISSIPPI.

Benton County.—Our people usually burn off their forests early in the spring, and the fires are easily controlled. For preventing their spread, we usually take advantage of roads and water courses, and plow around the fire. In this county the fires are generally confined to the district designed to be burned, very seldom extending beyond. The yearly burning off, tends to bring the fires under control, as there is little left on the ground. Some small timber is destroyed, but none of the large. Ordinary good sense and caution are all that is required for preventing damages from these fires. We usually select a suitable time, usually after a few days' rain, when the larger litter is still damp.—(*R. F. Lippard, Ashland, Miss.*)

Coahoma County.—The finest of forest timber exists, and grows rapidly in this great valley—more unscrupulous and terrible, if possible, than fire—exists here in *man*. He wastes, without a thought of future generations, the finest forests of cypress, oak, overcup, and white oak, many varieties of hickory, gum, maple, ash, catalpa, walnut, pecan, locust,

bois d'arc, mulberry, cottonwood, elder, and elm.—(*N. W. Lea*, Clarksdale, Miss.)

La Fayette County.—Since the country has become settled, forest fires have not occurred. When I first passed through this region, in May, 1832, the Indians were still here. It was the custom to burn the woods every fall, which kept down the undergrowth. The few large post-oaks were scattered sparsely over the hills, and the intervening spaces were covered with prairie grass and flowers, giving the whole country the appearance of a beautiful park. A deer could be seen at a distance of a quarter of a mile, and a carriage could have been drawn in any direction. After the settlement of the country, a penalty was imposed by law for setting fire to the woods, as the fences would be destroyed, and a thick undergrowth of black-jack has grown up, effectually destroying the grass and flowers, so that we are now no longer in danger of fires in the woods. This statement will apply to all the counties in Mississippi north and west of the prairie region.—(*P. H. Skipwith*, Oxford, Miss.)

Returns from Alcorn, Calhoun, Choctaw, De Soto, Grenada, Marshall, Noxubee, Oktibbeha, Panola, Prentiss, Sun Flower, Tate, Winston, and Yalabusha Counties report no destructive forest fires, and several of them state that such fires are altogether unknown. Allusion is less frequently made to the custom of burning off the leaves and litter than in some of the preceding States, although it is practiced in many sections.

(16.) TEXAS.

Clay County.—Our forests being what are known as "open woods," covered with grass, fires do no damage to timber. We burn after the 15th of March in each year, to clear the prairies of old grass, and fires generally run through; we never burn sooner, as the stock would suffer. It is to the interests of all to look out for fires before that time, and if accidentally fired, to put them out. Our laws prohibit firing before that time.—(*J. M. Stratton*, Benvanue, Tex.)

Grayson County.—No forest fires are known in this part of Texas, but fires caught from the sparks of a locomotive about the month of November, 1879, along the line of the Missouri, Kansas and Texas Railroad, in Indian Territory, and burned a month or more, and until extinguished by rain. The area of the burnt district cannot be stated, as the territory is not sectionalized, and I can only say that on either side of the road for a hundred miles or more, the fires run through the forest and prairie, damaging the grass and undergrowth to a very great extent.—(*M. Y. Brockett*, Sherman, Tex.)

Hancock County.—About 30 acres were burned over about the 15th of April, from the burning of logs and brush.—(*J. R. M. Davis*, Blackwater, Tex.)

Houston County.—We have had no fires in this or adjoining counties, and the statement will apply to the entire timbered belt of Eastern Texas. The woods are sometimes fired to burn off collected vegetable matter, decayed logs, &c. It is thought to be conducive to health, by destroying causes of malarial emanations, as also to improve the cattle range, giving fresh growth to the grass. &c. The Indians were formerly in the habit of burning the woods to check undergrowth, at which time the woods were vast open savannas. Now, the undergrowth is destroying the grass and very materially injuring the cattle range.—(*E. C. Douglass*, Crockett, Tex.)

Montague County.—We have had no fires yet, but they generally occur about the 15th or 20th of October, and continue till the 1st of March,

being generally caused by camp fires. They sometimes extend 40 or 50 miles towards the east, and from 100 to 300 miles towards the south, west, and north. The damage to the winter range towards the north, south, and west is being great to the stock men. The only suggestion I can offer is to stop men from camping. Fires, when left in the morning, appear harmless; but the high winds that we frequently have blow sparks to a greater distance than one would expect. Fires are sometimes started by parties prejudiced against the stock-men.—(*G. L. Davidson*, Queen's Peak, Tex.)

Tyler County.—A little damage has been done to the stock range in this county by fires in the pine woods, started by campers. About five leagues were burned over, and some pine timber was killed; the damage to the timber and the stock range was less than in previous years.—(*W. Hyde*, Woodville, Tex.)

Wise County.—We have very few fires that destroy much property. They generally occur after frost sufficient to kill vegetation, and generally from carelessness. We have laws against starting fires between the 1st of November and the 10th of March, with heavy penalties. It is usual for farmers to plow a strip around their farms to prevent the fires from spreading. Our section is mostly prairie, and the woodlands are open, and with not enough vegetation to make fire enough to damage the timber. The best safeguard is to keep abroad space around all improvements clear of inflammable matter. Fires have sometimes got into young timber and done considerable damage to the young growth.—(*J. M. Holmes*, Decatur, Tex.)

From most other counties correspondents reported no forest fires; many of them were in prairie districts, where the usual dangers from running fires were sometimes experienced and the precautions of plowing and burning safety-belts were all that were needed to prevent injury to improvements.

(17.) ARKANSAS.

Izard County.—The forests of this country are usually burned over annually in March or April, the fires being started from various sources, sometimes by lightning, but more frequently from the camp-fires of the movers, wagoners, and hunters. The means used for preventing their spread are, firing against them along well-beaten roads and small streams, taking advantage of rains and dews, successfully saving the fencing of nearly all the country. The standing green timber is not generally much injured by the burning of leaves and grass. Each farmer should keep an eye single to his own plantation, and protect it by keeping roads open close to his fences, which he should keep clear of combustible matter. These roads are sufficient, except in high winds, when firing along them is necessary.—(*Wm. F. Watkins*, Wild Haus, Ark.)

Jackson County.—Fires occur from the 1st of February to the 1st of July, generally being set. There are no forests that I know of that are not burned over during the time above mentioned. They do little injury to the standing timber, but sometimes consume staves, plank, &c. The only remedy appears to be rigid laws in regard to these fires, and their enforcement.—(*A. Barnes*, Coffeyville, Ark.)

Marion County.—Our fires occur generally in the spring, or latter part of winter, from the burning off of woods and fields, but generally no great injury is done, as we have always been able to arrest them by firing before them along roads or creeks in the hills. The woods are sometimes set on fire by movers, or by persons having no land, for sport,

just to see them burn, or by hunters, to burn the undergrowth, so that they can better see the game. No very great injury is done, except the burning of the mast. Standing timber is not generally greatly injured, except where there are fallen trees. These fires sometimes destroy boards and fence-rails, but not extensively. I can suggest nothing that will effectually prevent the firing of the woods. Irresponsible persons, boys, movers, &c., set these fires, without caring for what the injury may be. It is almost impossible to convict the offenders. It can be done so easily that proof of guilt is hardly ever made.—(*W. B. Flippin*, Yellville, Ark.)

Newton County.—Fires commenced about April 1, 1880, and continued three weeks. They were set by unprincipled men, and are usually kept out of farms by clearing roads around them. This proved successful where all the dead timber was cut, near the border, but some farms were almost destroyed. The damage was considerable, but cannot be estimated. As for prevention, I know of nothing short of making it a penitentiary offense for any man to set fire to the forest. In this county it is no uncommon thing for men to set fires in the forests in the spring time, which causes the farmers a great deal of trouble and considerable expense in having their fences burned and otherwise.

Prairie County.—We have a large extent of prairie country, which is burned over every year, and always with loss. Our fires in the timber do not injure it much, although probably they would if the materials were allowed to accumulate for a term of years. A few years ago a party of hunters set fire to the prairie in Arkansas County to see it burn, and after admiring it for a while they went on. This fire swept over the county, causing a loss of \$100,000. I lost the fence around 60 acres, and my houses and out-houses (then unoccupied), by a prairie fire in 1866, which was set purposely, and I know of many instances of heavy loss in this county within the last ten years from this cause. These fires are generally not severe enough to injure standing timber, but they kill the undergrowth. If the woods were not fired for four or five years, I have no doubt but that a fire would then destroy a great deal of timber. Sometimes in the bottoms, the cane gets on fire and kills nearly all of the timber.—(*R. B. C. Lee*, Devall's Bluff, Ark.)

Sharp County.—Fires occurred about March 15, 1880, and continued ten days. They were started by people to burn the undergrowth, and no attempt is usually made to stop them, except as they endanger fences or other property. These remarks will apply to Sharp, Izard, Fulton, Baxter, and Lawrence Counties, embracing about 18,000 square miles. The loss to timber was large, but as this is not an object, in most of these counties, no estimate can be made. The only measure that can be suggested would be the enactment of a law providing severe penalties against any one convicted of setting fires in the forest. This, however, would be difficult to enforce, as the county is sparsely populated, and the offender is seldom known. The undergrowth is kept burned out annually, for the alleged reason that it causes an early and luxuriant growth of wild grass for grazing purposes, but more damage than profit always results.—(*S. H. Davidson*, Evening Shade, Sharp County, Arkansas.)

Correspondents in Baxter, Clarke, Clay, Craighead, Crawford, Drew, Faulkner, Franklin, Grant, Hempstead, Independence, Izard, Johnson, La Fayette, Marion, Miller, Montgomery, Ouachita, Pope, Pulaski, Saint Francis, Scott, Sebastian, Sevier, Stone, Van Buren, Washington, and Woodruff Counties report no serious forest fires, but concur very generally in stating the fact that running fires are often set for the purpose of improving the pasturage, or from carelessness and other causes.

(18.) MISSOURI.

Camden County.—There have been fires, but they produced but little destruction. They occurred in March, and were generally set by the citizens, to burn out the small undergrowth. We have a statute making it a felony to set fire to the woods, but it is little respected in this county. Sometimes these fires do immense damage to farms and improvements, but this year they did not do much harm, perhaps injuring the standing timber 5 per cent., and other property to the amount of \$5,000. It is suggested that a law be passed, authorizing the firing of all forests on the 1st day of March, so that each citizen may be prepared to protect his property. It is fully demonstrated that where fires are kept out of forests, they soon become so entangled with undergrowth that all other vegetation is choked out.—(*L. J. Roach*, Linn Creek, Mo.)

Crawford County.—The timber in the counties of Phelps, Crawford, and Dent, in this State, are used (exclusive of that employed for farm purposes) in the manufacture of charcoal for making pig iron. We have no such destructive fires as are common in the Northwest, but the growth of the timber is greatly retarded, and it is often killed by the fires which come from the burning of the leaves during the winter and early spring. Active measures by the government would prevent this, and land which now sells for \$1 per acre would readily bring \$2 to \$3 if the timber once cut were allowed to grow unhindered by the fires.—(*G. F. Baker*, Midland, Mo.)

Dade County.—This county is about two-thirds prairie land, and the fires that do damage here are *prairie fires*; but of late years they are few and far between, owing to the fact that a large part of the prairie is fenced and under cultivation. I have lived in this county thirty-three years, and it is my opinion that there is as much as 500 per cent. more of timber in the county now than then.—(*W. L. Scroggs*, Dade County, Mo.)

Dallas County.—Forest fires are not frequent nor very destructive in this county, the injury being mostly confined to young standing timber, when there is a flow of sap, and to the fencing around the farms. Precaution is taken in burning (in the early winter or fall) to burn strips around the timber or farms from 30 to 50 yards wide after a rain, and when the fences and soil are damp and the grass dry enough to burn.—(*Frank Fowler*, Buffalo, Mo.)

Douglas County.—It may be estimated that half of Douglas, Christian, Webster, Taney, and Ozark Counties are generally burned over every year in February and March, the fires being set by hunters who care little for the rights of others. These fires kill down the young growth which sprouts up from the roots again, but becomes scrubby and dwarfish. There occurs every year considerable loss in fencing, buildings, and haystacks. Perhaps a heavy fine, going to informers appointed at suitable places, would prove effectual.—(*W. W. Daily*, Beaver, Mo.)

Hickory County.—Many fires occur annually, being set to burn off the old grass to make a good summer range. This is generally done by common consent, although contrary to law, and this remark applies to about a third of the county. The damage to timber can hardly be estimated, as it keeps down all the young growth. The only way to prevent the occurrence of these fires would be to enforce the law against those who set the fires. But it is claimed by some that the pasturage in the part burned over is worth more at the present time than the timber, as the land where the timber grows is not susceptible

of cultivation, being rocky, and there being more of it than there is need of timber at the present time.—(*H. H. Leggett*, Whiteland, Mo.)

Jefferson County.—Fires usually occur from the middle of April till August, and sometimes last a week. They are usually set by careless persons and hunters. The damage is mostly to the young timber. Thirty years ago the people were accustomed to set the woods on fire, spring and fall, in order, as they said, to have better pastures, not heeding the timber at all. Now there is a heavy fine, but we never find out the culprit. When the woods are on fire the residents turn out en masse and fight the fire day and night until it is completely subdued.—(*W. H. Powell*, Logan, Mo.)

New Madrid County.—No fires have occurred this year; but three years ago this fall, the leaves on the ground burned about ten days, but without killing the timber. They were set by coon-hunters starting a fire at night. Some two or three thousand acres were burned over, but without doing great damage. These fires are easily checked by sweeping a path all around them.—(*C. C. Thomas*, Point Pleasant, Mo.)

Shannon County.—Our people set fires in March, and ruin all the grass, and huckleberries, and the young timber, so that we can have no oak. I have preserved a little oak grove eight years, and this year it is bearing mast. I have done this to show my neighbors that my plan is a good one, and that we can raise more swine with less care. There is perhaps no remedy against these fires, unless fine and imprisonment, half of the fine going to the informant and half to the school fund. There is little chance to stop these fires when the wind is high, as I have seen them jump 60 feet at a time. The grass grows 7 feet high in many places, and it may well be seen how it will scorch the branches of trees sometimes 40 feet high.—(*W. R. Parkman*, Eminence, Mo.)

Taney County.—In the early part of 1880, much of the county was burned over, excepting the cultivated parts, and much injury was done to the standing timber, but not to other property. There is nothing that can prevent these fires, unless a strict execution of the State law concerning them, and a sure and speedy punishment of offenders for every violation. These fires are usually set by hunters to drive game, and there seems to be no means for preventing it. Farmers generally fire around their own premises, and let the flames have their way in the forest. The county is covered with forest trees, except as it has been cleared for cultivation.—(*J. J. Reynolds*, Forsythe, Mo.)

Vernon County.—About six-sevenths of this county is prairie, the only timber being in narrow belts along the larger water-courses. Our fires are therefore prairie fires, and these rage more or less every year, burning all in their course. A spark from a gun or pipe frequently starts the fire. They are not so destructive as timber fires, on account of the difference of the fuel. Experts in prairie fires easily control them by back-firing from some stream or road.—(*Albert Badger*, Nevada, Mo.)

Washington County.—The great trouble in all Southeastern Missouri is, we don't have forest fires enough to keep the brush down. The hills are getting so extremely thick with underbrush that they form a perfect wolf harbor.—(*P. L. Ramsey*, Belgrade, Mo.)

Wright County.—Fires usually begin in November, and continue at intervals till March, being usually set by hunters and people moving, or by those who set fire, as they suppose, to save their own property. The damage that has been done from this cause is beyond calculation, as there is but little timber but what is injured more or less by fire. In the spring of 1879, portions of Douglas, Texas, and Wright Counties

were swept over by fires, and some dwellings and other buildings were destroyed.—(*E. B. Giffin*, Hartville, Mo.)

In about twenty other counties in Missouri no important damages had occurred from forest fires, although in most of them the custom of burning for the purpose of improving pasturage is more or less practiced, and from this cause permanent injury to the existing forest growth has been observed.

(19.) TENNESSEE.

Anderson County.—Such fires as occur are generally from accidental causes, such as the burning off of clearings in April. The remedy appears to depend upon a rigid enforcement of the State law, which requires that fires shall not be started without first giving the neighbors a due and timely notice. A neglect of this excellent provision frequently leads to much loss of young timber and fencing.—(*J. K. P. Wallace*, Andersonville, Tenn.)

Grainger County.—Clinch Mountain, and Poor Valley Ridge, which run through this county, are generally burned over every year, as a matter of course. The fire merely takes the leaves and bushes, and allows the grass to grow up early in the spring, making a fine range for cattle and sheep. But little damage is usually done, except occasionally to fences on farms at the foot of the mountain and ridge.—(*C. C. Smith*, Rutledge, Tenn.)

Greene County.—No forest fires have occurred in the county within the year. Those that do happen are often set by parties hunting chestnuts in October, to burn off the leaves, so that the nuts are more easily found. This seldom does much damage.—(*J. A. Trim*, Greeneville, Tenn.)

The principal fires are set in the mountains on the south side of our county, by chestnut-gatherers, and burn at times for a week. They usually burn until extinguished by the rain. This remark will apply to Washington, Greene, Cocke, and Sevier Counties, which are divided from North Carolina by mountains. As these fires are started clandestinely, the parties setting them cannot be discovered.—(*Ephraim Link*, Greeneville, Tenn.)

Hamblen County.—Our fires are in the mountains, and the injury is limited to the timber. Clinch Mountain runs partly through Hawkins County. These fires are usually started by persons hunting for chestnuts, and the only remedy appears to be a law imposing heavy penalties when the persons who kindle them are detected.—(*R. H. Irwin*, Russellville, Tenn.)

Johnson County.—In March and April, 1880, some destructive fires occurred, destroying much timber. They appear to have run over several thousand acres, but the extent of damages cannot be ascertained. These fires appear to be more destructive to timber in the spring of the year, when the sap is up, than when they occur in autumn; but timber is always more or less damaged by these fires, whenever they occur. I would estimate the damage to woodlands by fire, within the last twenty years, as perhaps \$100,000. Besides this, there has been much loss of cord-wood for charcoal, and every year more or less of fences. I would suggest that more stringent laws be passed, with more severe penalties annexed, giving juries inquisitorial power to inquire into these offenses. Magistrates might be authorized and required to make similar inquiries. In 1872 a fire was set in the forests of this county by two persons, that destroyed thousands of acres of timber. Again, in 1878, late in the spring, a person fired the forests at another place, which also destroyed thousands of acres. The timber lost by these fires could not be rated

at less than \$25,000, estimating its value at \$1 an acre. It is high time that the most stringent measures should be adopted for preventing these fires.—(*Elijah Dougherty*, Baker's Gap, Tenn.)

Loudon County.—When fires get started in this county they never spread over more than two or three hundred acres. If they occur when the sap is up it kills the young timbers. Public opinion is against firing the woods. In the early part of my life it was common to burn the woods, to make range for stock, and fences were then frequently burned. Some twenty-five or thirty years since the legislature passed a law-making it an offense to put fire in the woods after the 10th of February, and the law and public opinion have put a stop to the custom.—(*S. J. Mason*, Loudon, Tenn.)

Marion County.—The mountains are burned over every spring for the benefit of the range for cattle, sheep, &c., but damages seldom happen from this cause.—(*P. T. Rankin*, Jasper, Tenn.)

Monroe County.—The only fires we have occur in the spring, in burning off the leaves, and the only loss is in the burning of a few pannels of fence or the killing of young timber, if the fires occur late in the spring, after the sap has ascended. These fires occasion no uneasiness, and are attended with little loss at the time. They are usually regarded as an advantage in clearing the land for summer range.—(*J. R. Gaines*, Glenloch, Tenn.)

Rhea County.—We have several thousand acres of mountain land, not inclosed, that is used for the pasturage of cattle, mules, horses, sheep, &c. It is purposely burnt off in February or early in March every year, that the grass may rise. Stock is put out in April, and remains till November, when it comes in fat for winter. It is thought that no loss results from these fires.—(*James D. McPherson*, Rhea Springs, Tenn.)

Rutherford County.—Forest fires are of very rare occurrence here or in this section. At the first outbreak of such a fire the whole neighborhood goes to work, and make a quick job of it. We believe in administering the "ounce of prevention" in time. There ought to be no difficulty in putting an immediate stop to such a fire if everybody goes promptly to work. If we had such trackless and uninhabited forests as those of the lumber regions, I think an enlightened people would demand of the legislature the employment of a force of police inspectors who could exercise the necessary authority in the logging and milling regions.—(*Chas. F. Vanderford*, Florence Station, Tenn.)

Stewart County.—No fires of consequence have occurred in 1880. Several acres were burned in April from fires supposed to have been started by hunters or persons wishing to get a range for cattle. We have been fortunate in thus escaping, but this and other large iron properties are subject to malicious and wanton destruction of timber by persons who live near by and have little or nothing to risk. Sometimes they fire the woods in order that vegetation may furnish grazing for stock; sometimes to destroy the leaves, so that a person can walk noiselessly through the woods without alarming the turkeys. At a remote corner of this property, some 3,000 acres have been made a barren waste by repeated burnings, supposed to have been done for the latter purpose. This year that spot escaped the hunter's brand. March and April are the months of danger from accident.—(*Joseph Vaulx*, Cumberland Iron Works, Tenn.)

Washington County.—Fires occurred in the mountains of this county in October last, and continued two or three weeks. They are supposed to have been set by persons who wished to improve the range, or to collect chestnuts. They were arrested by firing against them with good

success. Thousands of acres of mountain lands have been burned over, and much timber of inferior quality has been destroyed. The fires were mostly limited to the mountains.—(*H. Presnell*, Jonesborough, Tenn.)

In Bedford, Blount, Campbell, Cannon, Claiborne, Roane, Sevier, Smith, Sullivan, and White Counties, no unusual fires are reported, but the "annual burnings" are, in most cases mentioned, and sometimes with approval. A report, applicable to Sumner, Wayne, Lewis, and Hickman Counties, states that thousands of acres were burned over in March, April, and May, generally to make pasturage, and at other times by accident from clearings. This correspondent suggests that the only way to prevent these fires is by the offer of large rewards for information that may lead to the conviction of the persons who start them. "A strong law, vigorously enforced, would save millions of dollars' worth of timber in the country."

(20.) KENTUCKY.

Laurel County.—Fires occurred in several parts of this county in April, 1880, being usually set by teamsters camping along the roads and leaving their fires burning. The fire once blown among the leaves may spread over a large district of country before it is arrested. About one-tenth part of the county is overrun every year by fires, either accidental from fires thus left, or from fields where they are clearing. A great deal of standing timber is killed by these fires, or so injured that it falls into decay and is of little value except for firewood. A large amount of fencing is also burned every year, but not often a house. The remedy appears to depend upon more stringent laws in regard to the use of fires, in camping, or in clearing lands. Thirty years ago, it was customary to set fires every year, the farmers raking the leaves around their fields, and then setting fires to burn them up. This was done about the 1st of March, and as a measure of self-defense, to prevent any accident from fires that might be started.—(*John Pitman*, London, Ky.)

Lincoln County.—There have been no very destructive fires this season; such fires usually occur in March and April, when the leaves are dry, and the lands are being cleared. It is impossible to estimate the damages from this cause much timber is killed by burning around the roots, and since railroads have been constructed, the forests are being denuded rapidly.—(*J. A. Lytle*, Stanford, Ky.)

Owsley County.—There have been no fires to do any damage within the last year. There are some fifteen mountain counties in this part of the State, that are heavily timbered, and all the fires that do any damage in this region are in the spring, and are set by persons in clearing the ground. They sometimes destroy fences, as the leaves being then very dry, the fires are sometimes hard to stop. These fires do but little harm to the large timber, but they kill down the undergrowth.—(*J. J. Gilbert*, Boonville, Ky.)

Shelby County.—From the kinds of timber growing in this county, forest fires are unknown. Sometimes, where the timber is very dense, the leaves will burn over in the fall, but the damage is chiefly to fences and the killing of the small undergrowth. Some fifty years ago, when our forests were almost intact, in some localities, it was not uncommon for the leaves to take fire in the fall, from the carelessness of hunters or of indiscreet persons, and whole neighborhoods would be rallied to stay the ravages of the flames, to prevent the destruction of decayed timber

and fencing. This was usually the extent of the damage.—(*J. D. Guthrie*, Shelbyville, Ky.)

The other correspondents in Kentucky report no serious fires during the preceding year. Some of them allude to a former practice of setting fires for the purpose of improving the pasturage, when the country was newer, but this has been in a great degree discontinued as the country became older, and its injurious tendencies were better realized.

(21.) WEST VIRGINIA.

Braxton County.—What are termed wood fires occur every year, but they are not very destructive to timber. They are most apt to occur about the 1st of March, and usually are set from the clearing of new land. The fires have happened in detached parcels, so that the area cannot well be estimated. These begin in the flats and slopes running up to the mountains, and they generally burn till they die out.—(*J. L. Rhea*, Flatwoods, W. Va.)

Calhoun County.—Some twenty-five years ago it was common for fires to spread all over the forests, being started by parties who hunted for a livelihood. Perhaps the best remedy against forest fires, would be the prosecution of those who set them, and holding them responsible for damages done through their neglect.—(*William Barr*, Grantsville, W. Va.)

Gilmer County.—Fires occurred to limited extent early in the spring, generally from clearings, and the amount burned annually would not probably exceed 1,000 acres in the county. The loss may be estimated at \$5 an acre, besides fences. There can perhaps be no preventive measures better than a stringent law well enforced. We have a law that makes a person liable for the damages that may be done by the fires that spread from his clearings, or otherwise. But timber has so little value that I never knew a case in which the law was put in force against any person for an offense of this kind. In most cases of clearing the timber, except such as is needed for fencing, is burnt on the ground. That which stands near enough to some stream large enough for floating is always saved, if it will make staves or saw-logs. There are thus thousands of dollars' worth of timber annually burnt to get it out of the way. This remark applies not only to this county, but to many others south and east, as there are no means existing for getting the timber to a market. All along the Little Kanawha River and its tributaries, the timber large enough for use, has, with few exceptions, already been culled out. There is a large amount of timber suitable for railroad ties still left, but there are no means available for bringing it into use. This applies also to many counties to the south and east.—(*Henry Neff*, Troy, W. Va.)

Grant County.—Fires commenced in April, on the west end of this county, on the top of the Alleghany Mountains, and continued about two weeks, until extinguished by rain. They are generally set on purpose, as it is the custom of the people here, for the purpose of getting a fresh start of the sprouts and weeds, as a pasturage for cattle and sheep. They are also often set in the clearing of lands, when it is too dry.—(*G. Naedell*, Grant Court-House, W. Va.)

Greenbrier County.—At least 10,000 acres are burned over every year in this county, in April and May. In the western part there is a large district of land very little improved, and the fires are set to keep down the brush and secure pasturage.—(*H. Handly*, Lewisburg, W. Va.)

Hampshire County.—There have been some extensive fires in this

county, generally occurring in the fall of the year, but some in the spring. They are usually started by hunters, and those wishing to improve the range, or by clearings. Our county contains 580,000 acres of land, at least two-thirds of it forest, chiefly chesnut, oak, and varieties of pine. Our forest fires sometimes run over an area of several square miles, and the same is true of the adjacent counties of Handy, Grant, Mineral, Pendleton, and Morgan. These fires do considerable damage, especially to the young growth of timber, besides to fences, &c. There should be a rigid enforcement of existing laws against the firing of woods by hunters and graziers, and more care in the burning of brush-heaps in the clearing of new lands; perhaps additional legislation is needed.—(*A. W. Kerchwell*, Romney, W. Va.)

Hardy County.—Forest fires were frequent in April and May last, and, as nearly as can be ascertained, some 12,000 or 14,000 acres were burned over with a great loss.—(*J. W. Duffy*, Moorefield, W. Va.)

Fires commenced about the 15th of April, and continued until extinguished by the rain. The area burned was about 5,000 acres, and most of the timber in its course was killed. They began in the west end of Frederick County, Virginia, and spread into Shenandoah County, Virginia, and into this county.—(*L. B. Wilson*, Caper Iron Works, W. Va.)

Kanawha County.—A fire began in October, 1879, and burned a week, extending 8 miles by 10, destroying, in its course, many miles of fences, and a few small houses. It was finally extinguished by the rain.—(*J. F. Johnson*, Perryville, W. Va.)

Monroe County.—We have fires annually in Peter's Mountain, one of the Alleghanies, usually in the latter part of April, or first of May, but occasionally in autumn. They are usually set for the purpose of increasing the range, and but little is done to limit them, unless they endanger farms along the base of the mountains. Immense damage was done to the young timber by these fires, which extended some 25 miles in length, by from 3 to 10 in width. The pecuniary loss was not relatively large, as there is no market for it; while people continue to pasture the mountains these fires will happen, as they are believed to greatly improve the range. No other parts of the county are liable to suffer from these fires.—(*L. Ballard*, Lindside, W. Va.)

Morgan County.—Extensive fires occurred in this county, from about the middle of April to the last of May. They probably burned over 10,000 acres in this county, and killed a vast amount of timber, as they occurred when the sap was in the timber. Perhaps the damage to timbers might be estimated at \$25,000, besides \$5,000 worth of bark, railroad ties, and hoop-poles, and \$3,000 worth of fences. These fires are supposed to have been set by men who were peeling bark. Some were kindled by locomotives of the Baltimore & Ohio Railroad. Perhaps the most effectual means of prevention would be the enactment of laws making it a penal offense to set fires in the forests, offering a reward for the discovery of the guilty parties, and making them responsible.—(*Samuel Whisner*, Great Cacapon, W. Va.)

Pocahontas County.—Forest fires occur annually, beginning in any dry time, and often continuing until wet weather. They are generally set by persons who wish to improve the range for stock, and occasionally they spread over a large tract of mountain lands, of which there are much in this county. The standing timber is very much injured by these fires, especially when they burn up hill. Forest products prepared for market are not much endangered, because they are generally got down to the river before they are entirely dry. It may be estimated that the

damage to fencing amounts to \$1,000 a year in this county. As for preventive measures, the temptation is so great to the poor people, to get fresh range for young stock, that I am at a loss what to suggest. We have laws already forbidding the practice, but they are not enforced. As a means for preventing the spread of fires, they are generally fired against when they approach improvements.—(*John Ligor*, Clover Lick, W. Va.)

Randolph County.—In an area of some 4,000 acres, perhaps 33,000 are burned annually. Fires are most apt to occur in the last of April, or first of May, sometimes through carelessness in clearing land, but sometimes they are set by worthless men or boys, to see a big fire, or to burn through malice a neighbor's fences.—(*M. W. Bradley*, Valley Bend, W. Va.)

Tucker County.—It may be estimated that 20 square miles were burned over in this county in the early part of May, 1880, being started from fires set in clearing land. These fires can only be checked by having more stringent laws, and having them more rigidly enforced.—(*D. S. Minear*, St. George, W. Va.)

From sixteen other counties in West Virginia, it was reported that there had been no fires, or that there had been but slight and unimportant ones. They are generally attributed to the burning of brush in the clearing of lands, or more rarely for improving the range for stock.

(22.) OHIO.

Lawrence County.—Three fires occurred in the spring of 1880, but they were seen by two watchmen employed for the purpose, and extinguished before much damage was done. Before these watchmen were employed the area burned over in some years was hundreds and even thousands of acres. Forest fires will only burn rapidly in dry windy weather in winter, and especially in March and April. A good system of guards employed by the government, or by the owners of timber lands, would probably prove the most efficient means for preventing these fires.—(*A. R. Mackintosh*, Hanging Rock, Ohio.)

Lawrence County.—No destructive fires have occurred within the year, but about seven years ago, in the month of October, large areas of growing timber were burnt over in this vicinity, and great damage was done. These fires are occasioned mostly by hunters, who carelessly or purposely fire the woods. We cannot suggest any remedy, as it is very difficult to get sufficient evidence to convict, under the laws of the State.—(*Means, Kyle & Co.*, Hanging Rock, Ohio.)

Ross County.—We have had only local brush fires during the year, but in 1879, a fire began September 15th, and continued several weeks. It was set by locomotive sparks, and from fires set by brushes burning, and burned over perhaps 2,000 acres of hilly ground, doing damage, to the timber, variously estimated at from one to two thousand, to five or six thousand dollars, besides burning a large number of rails and fences, and much timber for barrels. There should be something done by railway companies to prevent locomotives from throwing sparks, or they should be required to keep the sides of the track clear of leaves, brush, and weeds. Quite an amount of wheat in shock, was destroyed one year ago, by sparks from passing locomotives on the Marietta and Cincinnati Valley Railway, as also much injury to meadows, amounting to \$1,500.—(*Hon. M. McCoy*, Kinnikinnick, Ohio.)

Sciota County.—This is, for the most part, a rough hilly country, the hills being covered with timber, some of it being the most valuable of

the hard woods, such as oaks, hickories, black locust, and a great deal of second-growth oak, hickory, ash, elm, &c. It is well settled along the creek bottoms, and no destructive fires have occurred for many years. Sometimes, however, in October, or early in April, the west part of the county has destructive fires, damaging some of the large timber, and killing the young growth. These fires originate in the careless burning of brush heaps, which, communicating to the leaves, may spread over perhaps, a hundred acres.—(*W. M. Thomas*, Lucasville, Ohio.)

Vinton County.—One thousand acres of timber land, belonging to the Eagle Furnace property, were burned over between July 8 and September 10, as is supposed from the burning of underbrush. The fires were finally subdued through the efforts of gangs of men. A system of clearing about 50 feet wide around all division lines of large bodies of wood land, is recommended as a preventive measure.—(*J. B. Randall*, McArthur, Ohio.)

Forest fires occur to a greater or less extent annually; a few are caused by accident, nearly all are started by persons who wish to pasture their cattle. As frequent firing destroys all the young timber, and exposes the surface to the action of the sun, which in time starts the growth, and otherwise impairs the quality of the large timber, the actual damage is greater than would at first thought appear. The laws make parties convicted of setting fires liable for the damages, but such men are irresponsible.—(*J. W. Yeley*, Hamden Junction, Ohio.)

From sixty-three other counties of Ohio, reports were received informing that either there had been no fires, or none worth mentioning within their limits, during the last year. The former frequency of destructive fires is repeatedly mentioned, chiefly as the result of careless clearings, and the practice of burning to improve the range of cattle appears to be almost entirely unknown. Whenever any remedies have been suggested by these correspondents, they have generally been the enforcement of more stringent laws with regard to burning of brush, requiring this to be done only at a safe time, and under sufficient supervision, and the holding of persons to accountability for the damages that may result from their carelessness.

(23.) INDIANA.

Adams County.—No fires have occurred in this county since 1872. They were confined by vigorous efforts, such as plowing around woods, back-firing, and the use of earth, in a portion of two townships.—(*A. C. Gregory*, Decatur, Ind.)

Brown County.—Fires were set by carelessness on the part of some squatters in burning off brush and logs, about the 15th of April, and continued two weeks. They burned over about 3,000 acres. It is difficult to estimate the damage done to standing timber, as many valuable trees were slightly scorched and if there is a small dead place in the bark, worms destroy the tree; many fence rails and much fencing timber were burned, and nearly all the farm fences around the woods were lost. If farmers would keep their fence corners clean, and a good open pass-way several feet wide around the outside of their farms, it would afford them a great, though not an absolute, protection. The prevention of forest fires is one of the most difficult of questions and it is hard to find any valuable suggestions that could be relied upon in all cases. A thorough organization of citizens, into small companies, with suitable men as marshals and other officers, might do much good in arresting the spread of fire, but with unfavorable winds, it would then be almost impossible at times to stop it.—(*Alfred Williams*, Nashville, Ind.)

Carroll County.—No forest fires have occurred during the year. They could only happen early in the spring or in the autumn after the leaves fall. Our prairies were formerly swept annually by great conflagrations, but now, since the country is more thickly settled, they do not occur to any great extent. These remarks will also apply to Cass, Clinton, Howard, Jasper, Tippecanoe, White, and other adjoining counties. If fires are not maliciously started, there is not much danger from them.—(*Isaac Jackson, Delphi, Ind.*)

Clay County.—We have rarely had a forest fire within the last decade. They used to originate in our small prairies, which are now all under high cultivation. Our forests are of hard non-resinous timber, having little inflammable material, excepting the dry fallen leaves which, in former years, were set on fire by the hunters. The raccoon, the deer, the hunter and the frontier are things of the past with us. We formerly arrested fires by raking the leaves off a space a few feet in advance.—(*James Ferguson, Ashborough, Ind.*)

Floyd County.—In November, February, and March, fires were started from gun-wads, and continued a few hours, but were stopped by raking the leaves, plowing, and the use of water when accessible. The areas burned over in this county seldom exceed 100 acres. The county is thickly settled, and when a fire breaks out, the whole neighborhood turns out to fight it.—(*W. W. Tully, New Albany, Ind.*)

Gibson County.—This county is not subject to forest fires. The principal timber land is in Wabash bottoms, which are subject to overflow.—(*C. A. Slayback, Princeton, Ind.*)

Hancock County.—There have been very damaging fires, the first one started October 15, and the others a few days later. They were set by locomotives, and overrun about five miles square, chiefly improved farms, doing injury to the timber to the amount of probably \$5,000, besides \$700 worth of cord-wood, \$300 worth of rails, and an unknown amount to barns and other buildings. It is suggested that railroad companies be made responsible for the damages that result from their carelessness.—(*H. Black, Philadelphia, Ind.*)

Jasper County.—A small fire broke out on election day (November 2), and continued two days, running over perhaps a thousand acres. The damages to timber were not large, but one small farm was completely burned over, including buildings, grain, hay, and fences.—(*I. S. Coen, Rensselaer, Ind.*)

Jay County.—We had a great forest fire here about eight years ago, which destroyed much valuable timber and fencing. It was set (unintentionally of course) by coon hunters. The amount of damage is not remembered, but it was very great. The air was so thick with smoke that we were hardly able to breathe or see, and the anxiety was very great.—(*William Hilton, Portland, Ind.*)

Jennings County.—We have had extensive forest fires in years past, but none the present year. They caused a great loss of fine poplar and oak, and probably a fourth part of our timber has been destroyed by fires. They generally originated through the carelessness of hunters, but we have had some very destructive fires from locomotives. They are generally stopped by back-firing.—(*J. B. Smith, Queensville, Ind.*)

Kosciusko County.—No fires have occurred within the year, and we have had none recently. They have usually been caused by the burning of brush or marshes, and are generally stopped by raking and burning the leaves before the fire. Four years ago we had some heavy fires in the woods in this county, destroying a vast amount of timber, wood, rails, fences, &c., and in some cases plowing was resorted to, to check the progress of the fires.—(*A. M. Saunderson, Leesburg, Ind.*)

Steuben County.—No forest fires have occurred in the present year. About the middle of September, 1871, there were destructive fires in black-ash and tamarack swamps, that did not subside till late in December. They were started by the wadding of the sportman's gun and by burning brush heaps. They burned about 1,200 acres more or less in every township, but mostly in the southern part of the county. The damage may be estimated at \$20,000 to timber, \$16,000 to land, \$10,000 to standing timber, and \$36,000 to fences, total \$82,000. As preventive measures the people should be kept from hunting in very dry weather, and farmers should be prohibited from burning brush at such times.—(*Thomas Tasker, Angola, Ind.*)

Warren County.—There have been no fires in this county since 1872, at which time much damage was done, not only to woodlands but to other farm property. The fire was confined to a belt about 5 miles long and 3 wide, and was started by men who were hunting and left fire in an old stump. The damage was mostly to young timber. There was a great drought prevailing in the county at that time.—(*G. H. Lucas, State Line City, Ind.*)

Correspondents in thirty-two other counties report that no fires of importance have occurred within the year, although in many cases they were formerly frequent. They had usually been started from clearings or by the carelessness of hunters.

(24.) ILLINOIS.

No important fires were reported in this State, excepting prairie fires, which were becoming every year less frequent as the country grows older, and the need of caution in the care of fires becomes more apparent.

(25.) MICHIGAN,

Antrim County.—No destructive fires have occurred in this region in 1880. As a means of prevention, there should be laws restraining reckless land owners from setting fires during the summer and autumn, for burning over extensive choppings, without giving due notice to adjacent owners of timber lands, and a stringent law compelling camping parties to put out all fires before leaving them. Some of our worst fires result from these camps. If it were in the power of land owners to post notices upon their premises, quoting the law and its penalties, it would be of much use.—(*Elk Rapids Iron Company, Elk Rapids, Mich.*)

Bay County.—There have been no forest fires within the present year. The most destructive fire we have ever had, was in 1871. The last one that did any considerable damage was in 1877. There is a large amount of fallen timber in the woods, and I expect to see a very destructive fire the first dry season we get. The fires generally spread from the clearing fires of new settlements. There are hundreds of acres of unimproved timber land in this county, with not a single green tree standing.—(*Samuel Rowden, Auburn, Mich.*)

Cheboygan County.—Fires appeared about the 1st of July, and continued about four weeks, burning over some 50,000 acres, chiefly in Cheboygan, Prospect, and Otsego Counties, causing a damage of probably \$40,000. Fires are most apt to occur in this region in July and August, and it is often hard to say how they originate. It is sometimes from settlers' clearings, but oftener from the carelessness of hunters, or land-lookers, or from smokers.—(*P. H. McDonald, Scova, Mich.*)

Chippewa County.—This county has, say 1,500,000 acres, of which about one-fifth is pine. When we have fires, they generally originate from

land-lookers and others, who leave neglected fires. Upon three several times we have had destructive fires within the last seventeen years. In an extraordinarily dry season they are almost sure to occur in some part of the county, and there seems to be no way of preventing it.—(*T. K. Easterday*, Sault de Ste. Marie, Mich.)

Grand Traverse County.—No serious fires have occurred during the last season in the counties bordering on Great Traverse Bay; they generally start from the burning of timber in clearing land, but frequently from the camp fires of picnic parties, &c. The Traverse Bay section has been very free from damage by forest fires. Mission Point light house fraction, covered with humus had the timber mostly killed in a dry season by the fire burning over the ground, and large hemlocks had the mould burned from under them, leaving the trunks standing as it were on stilts, still held up by the roots, but dead from the heat. Cordwood, bark, cedar posts, and other forest products have been lost in former years, but not in the present. Fires on the beach are mostly started by careless campers (pleasure seekers, hunters, and fishermen), and no remedy can be suggested for preventing them.—(*Geo. Parmelee*, Old Mission, Mich.)

Houghton County.—Fires started by sparks from locomotives on Mineral Range Railroad began August 1st, and continued a month. They were extinguished by water drawn on wagons and used with pails. They burned over about a mile square in Franklin and Quincy townships, where the timber had been formerly much injured. The damage was about \$1,500, besides \$700 to cordwood prepared for fuel. No preventive measures can be recommended.—(*J. Chassell*, Houghton, Mich.)

Ingham County.—No important fires have happened in this county since the great fire of 1871, and as the county is now well settled up, nothing like forest fires of any general character will ever again be likely to occur within our limits.—(*L. M. Ives*, ——— Ingham County, Mich.)

Manistee County.—Some hundreds of acres of timber were destroyed in the early part of May, in this county, being set, it is supposed, by tramps. As the country becomes more settled the danger from this cause becomes less.

Marquette County.—We have had no forest fires in this county within the past year, but they generally occur in spring, say in May, and are occasioned by farmers burning brush, or sometimes from hunters, but most frequently by sparks from locomotives. We prevent fires from spreading by throwing dirt, with shovels, upon the border of the fire.—(*Iron Cliff Company*, Negaunee, Mich.)

Muskegon County.—I am operating two blast furnaces in the counties of Muskegon and Van Buren, and for the fuel, which is all charcoal, we use about 80,000 cords of wood per annum, and clear about 2,000 acres of land. We have had no fires during the past year, and attribute much of our good fortune to a wet season during the summer. The only precaution we take against fire is to clean up our tops and brush when chopping wood.—(*H. S. Pickands*, Fruitport, Mich.)

Oceana County.—A portion of Newaygo County and the adjoining counties is covered with valuable forests of pine timber, and in seasons of drought, extensive fires are common, frequently destroying or materially injuring extensive tracts of timber, but the frequent rains of the last season have prevented these fires to any extent, so that the injury has been less than in any year since the settlement of the country.—(*Melvin W. Scott*, Hesperia, Mich.)

Presque Isle County.—Fires occurred in towns 36 and 37 north, range

3 east, during the month of June, 1880, from camp fires of travelers, destroying about 1,000,000 feet of pine.—(*A. E. Banks*, Rogers City, Mich.)

From thirty-one other counties in Michigan, correspondents report that no serious forest fires have occurred during the last year. They generally refer this exemption in part to the unusual rains that had occurred, and mention the damages that had resulted in former years. Several of them refer especially to the great forest fires of 1871 as memorable in their annals of disaster, and often express the remark, that as the country is settled up the chance of injury from this cause is becoming less.

(26.) WISCONSIN.

Adams County.—There have been no destructive fires in this region since 1874, when a fire passed over the eastern portion of the county amounting to about four townships, destroying thousands of dollars' worth of timber and several houses, barns, &c., and much fencing, amounting to at least \$10,000 in value.—(*Hon. O. B. Lapham*, Friendship, Wis.)

Barron County.—Fires appeared in this county about October 1, and continued about two weeks, having been started through the carelessness of hunters and from the fire of clearings. They ran through three towns in this county, and a part of Polk and Bennett Counties, and did damage to the amount of \$20,000 to the timber, about \$5,000 to forest products prepared for market, and about \$6,600 to farm property. These fires can perhaps best be prevented by a law imposing heavy penalties, in fines and imprisonment, upon those who willfully or carelessly start them in a dry season or allow them to escape from their premises, and by rigidly enforcing it. We have laws in this State against the setting of fires, but they are not enforced as they should be, and it is often difficult to find who the criminal is.—(*W. W. Flinn*, Moose Ear, Wis.)

Buffalo County.—Fires began about the 1st of April and continued through that month, having been set by parties wishing to secure wild pasturage, and the prairie portion of the county was overrun, causing damage to the standing timber and other property, of uncertain amount. The enforcement of penalties, as provided for by existing laws, appears to be the best remedy.—(*Wm. B. Faulds*.)

Calumet County.—No forest fires have occurred in this or neighboring counties since the great Peshtigo fire of 1871, when so extensive damages were done in this State and Michigan.—(*C. Oeson*, New Holstein, Wis.)

Chippewa County.—Several thousand acres were overrun by fires in the month of October, from about the 8th to the 16th, destroying, besides timber, a quantity of hay and fencing and a few buildings. The damage to standing timber, hard wood and pine, was immense. These fires occurred from different causes; some from camp-fires, others from clearings, and some, no doubt, were set on purpose. Some attempts were made at back-firing, to protect buildings, fences, and haystacks, and with success in some instances, until a fortunate rain extinguished the fires.—(*W. B. Bartlett*, Chippewa Falls, Wis.)

Douglas County.—Fires have been running through our forests more or less in the months of May, June, July, August, and parts of September and October. They were started by farmers, hunters, explorers for timber, and those searching for copper and other minerals. They run more or less over six townships, but it would be impossible to state the

damages. Pine timber is killed by these fires, and if got off before the saw-worms destroy it, the lumber may be saved, or at least most of it, but the other kinds will be burnt or rot on the ground. Besides the standing timber, about 400 cords of wood and a large quantities of telegraph-poles and railroad ties were burned. As for remedies against these fires, there are perhaps none, unless clearing and cultivation. The lumbermen will keep a fire in the woods as long as it pays to lumber on these lands. We are rapidly using up our timber, and it requires no prophet to foresee the time when the forests upon which we now rely will no longer exist. If matters go on as they are now going, wood for all purposes will become scarce and high-priced in this country long before the boys and girls now in school become men and women.—(*Leonard F. Wheelock, Superior, Wis.*)

Fond Du Lac County.—In reply to the inquiry for any facts of historical importance relating to forest fires in former years, the correspondent from this county says:

Twenty-five years ago our openings were sparsely covered with large burr and white oak trees. They have all disappeared, and in their places, anywhere that the land has not been cultivated, we have fine groves, and no country is set off more beautifully in this respect than ours. Some are being cut away, and yield 20 to 25 cords of good solid wood per acre. Ten years ago wood was worth from \$5 to \$7 per cord; now it is down to from \$2.50 to \$4 per cord. Thousands of acres have been cleared in our county, and still we have a better supply of wood than we had twenty years ago.—(*E. Reynolds, Metamora, Wis.*)

Monroe County.—There have been no forest fires in this county within the last ten years. There has been a vast amount of damage done to standing timber from this cause. The timber injured was principally white pine growing on dry sandy ridges, with two railroads running through it, and the fire from the engines was the principal source of the trouble. In most cases, before the fire is discovered it is so far spread that no means have been used to prevent its spread.—(*W. W. Jackson, Tomah, Wis.*)

Pierce County.—There have not been any unusually destructive fires in the county within the year, but some occurred in the summer and fall, usually escaping from clearings. They may have burned over 3,000 acres, causing a damage of perhaps a dollar an acre, and \$2,000 to forest products prepared for market. No measures can be suggested excepting greater precautions enforced by heavier penalties for neglect.—(*J. A. Mapis, River Falls, Wis.*)

Polk County.—Fires have occurred to some extent in this region during the past year, but there are so many swamps, lakes, and creeks that no very large area can be burned over at one time. Perhaps 500 acres may have been burned over in Bennett and Polk Counties, with the loss of about 500 tons of wild hay. Since the county is being cleared up for settlement, the burning of wood-lands has not been regarded as a great calamity.—(*D. Meare, Osceola Mills, Wis.*)

Sauk County.—Fires overran a few square miles in this county in the month of April, having been set by railroad engines. The damage done was mostly to young trees, and future generations only could estimate the amount of loss. As a preventive measure, it is recommended that a man be appointed in every town who shall be required to summon a force large enough to stop every fire as soon as possible after the beginning.—(*H. T. Haskin, Prairie Du Lac, Wis.*)

Rock County.—Twenty-five or thirty years ago, before the country became settled and fenced, forest fires were common, but since then none have occurred to do any damage.—(*R. T. Powell, Indian Ford, Wis.*)

Winnebago County.—This section of the country has become entirely free from the ravages of forest fires. There is but little forest in the county. Originally this region was mostly oak openings or prairie, but it is now all settled up and covered with improved farms, and a "prairie fire" is almost entirely unknown.—(*James H. Foster, Koro, Wis.*)

In thirty-one other counties no important forest fires had occurred during the previous year, and in quite a large number of them these accidents are mentioned as becoming more unusual in recent years, as the country has become better settled.

(27.) MINNESOTA.

Isanti County.—Fires occurred about the 1st of April, as was supposed from the railroad, and overrun several townships of land, destroying a large amount of timber and several large lots of cordwood, besides much hay. The amount of damages cannot be estimated, and very little organized effort was made to arrest their progress, each neighborhood striving to protect its own interests by plowing, &c. We need more stringent laws against the setting of fires, and more care on the part of railroads, as three-fourths of the fires are from that source.—(*S. Henderson, Oxford, Minn.*)

Morrison County.—Some fires occurred in the pineries, but definite information has not been ascertained concerning the extent of their spread or the amount of their damages. The injury to standing timber was at least \$2,000, besides 400 tons of hay, worth \$1,600, and other damage done to lumbering camps. The only means of preventing or diminishing the damage from fires are the enforcement of penalties now provided for in State laws, and greater care in the construction and running of engines. The people should be more generally informed on the subject, including the Indians who roam about the country. After fires are once started and spreading, there appears to be but little use in trying to stop them beyond the measures that are now employed.—(*H. Richardson, Little Falls, Minn.*)

All other correspondents in Minnesota who made returns reported that no serious forest fires had happened during the past year within the districts which they represented.

(28.) DAKOTA.

Armstrong County.—This is almost wholly a treeless region—a prairie country. The borders of our streams are fringed with willow, and in many places where the annual fires are kept out, the ash is springing up. There is no way in which the planting of this region could be more rapidly advanced than by the distribution or cheap supply of seeds and cuttings of forest trees. The white willow, cottonwood, box-elder, ash, and walnut are especially recommended in this region.—(*H. Bowen, Martella, Dak.*)

Bon Homme County.—We have prairie fires from the time that the grass gets dry till May or June. Most of the farmers make *fire-breaks* by plowing and firing when there is no wind. These fires often do much damage to plantations of young trees on timber claims. Perhaps these prairie fires could be best prevented by a law that should require every farmer to provide safety belts at least two rods wide, to be kept clear of grass, and by making the duty of the roadmasters to burn off the roads within the limits of the highway. These prairie fires are altogether

the worst enemy that we have to contend with.—(A. Zienert, Tyndall, Dak.)

Burleigh County.—Prairie fires are the scourge of the country. They begin in October, and are generally started by locomotives or by hunters. This year they occurred quite frequently for a hundred miles east and west from Bismarck, destroying much hay and wheat, and all the young groves of timber that when protected spring up every year. These in ten years would do much towards supplying the timber that the country needs for its use. If the people generally would plow around their farms, and especially their timber groves for a few years, these fires would cease to be troublesome.—(J. M. Ayer, Fort Abraham Lincoln.)

Lawrence County (representing the "Black Hills" country, including the counties of Custer, Pennington, and Lawrence).—We have had no forest fires worth mentioning the present year, but they did great injury in former years, generally from the middle of August to the 1st of October. They have generally originated from carelessness in leaving camp-fires, but sometimes have been started by incendiaries. In 1878 and 1879, these fires were *very severe*, chiefly in Lawrence and Pennington Counties, and in these years perhaps one-eighth part of our live timber was killed, on an area of 1,000 square miles. This timber, if within reach of a market or the mines, would be worth more than the government price. Miners pay from \$3 to \$5 per cord, and will soon be compelled to seek for other fuel. Over 5,000 cords of wood were burned in the years above mentioned, and in Forest City, on Nigger Hill, in Bear Gulch district, Lawrence County, every house but one was burned. This is near the Wyoming line, and the fire came from that Territory. In Castleton, Pennington County, ten houses, and many miners' cabins were burned, besides other improvements that can hardly be estimated. The measures employed for limiting these fires are back-firing and plowing around the fire, but in these pitch-pine woods the only way for us is to flee for our lives into the tunnels and other safe places. As for preventive measures, I would recommend the following:

1st. A heavy penalty upon any one using fire for clearing land or otherwise and letting it get beyond control.

2d. A still heavier penalty for any one leaving a camp-fire or a fire made for any other purpose without thoroughly extinguishing it.

3d. A still heavier penalty on any one convicted of incendiarism, and a reward to the prosecuting witness who shall procure his conviction. Such cases are believed to have occurred where the fire was started to destroy the winter pasturage, to compel the herdsmen to seek some other locality, and in other cases to destroy haystacks for the purpose of consuming the hay.

Probably one-third of the forests of these "hills" has been destroyed by fires running into the timber from the plains, and this must have occurred many years previous to the settlement of this region in 1876. I am thankful to see that the government is likely to take this subject in hand, for the importance of having a regular supply of timber for these immense plains is very great; and allow me in this connection to urge the importance of planting these "hills" *with white pine* as fast as they are cleared. At present our only supply of this timber comes through Chicago.—(John Mabbs, Deadwood, Dak.)

Turner County.—We have no natural forests, but prairie fires do immense damages, beginning to run as soon as the grass gets dry in the fall, and starting from causes unknown. In Turner County alone, last fall, at least, \$15,000 worth of property was burned, consisting of houses,

barns, and stacks of hay, &c. A few small groves were burned, but the loss cannot be ascertained. Two children perished in a burning house.—(S. F. Andrews, Swan Lake, Dak.)

From ten other counties returns were received informing that the only fires that had occurred, were *prairie fires*, from which much loss is suffered every year. The enforcement of care in providing against these by plowing around farms and along section lines is repeatedly urged, and this should be secured by law.

(29.) COLORADO.

Laramie County.—Along the Rocky Mountain Range very destructive fires have prevailed, ruining large tracts of pine timber. They occurred at intervals of three or four weeks, from May till September, and are supposed to have been set by hunters. It is impossible to make any estimate of the extent burned over, or the amount of damage done. The range within view of this place must be 50 to 75 miles in extent, north and south, and it is certainly 20 miles wide, and fires have raged here and there all along this chain. Some measures should be devised for preventing this carelessness; but it would be very difficult and expensive. The wanton destruction of timber and forests all along the mountains is sometimes fearful. Hunters and sportsmen should in some way be made to suffer for these depredations.—(A. E. Blount, Fort Collins, Colo.)

Douglas County.—Fires began about the 1st of June and continued all summer. They were set by Indians and careless campers.—(L. W. Wells, Sedalia, Colo.)

Boulder County.—We have had no mountain fires this year, but in 1879 they prevailed very extensively all along the mountains. They were said to have been set by the Indians, and at one time the smoke was so dense as to be almost suffocating. They burned for several weeks, and no means were used to extinguish them.—(I. J. Bartlett, Longmont, Colo.)

Rio Grande County and Weld County.—No fires have occurred in these counties within the year.

In 1869 fires prevailed extensively among the mountains in Colorado, doing damages to the amount of perhaps a million of dollars. Extensive fires also occurred in the western part of the State in 1879, and it has been estimated that half of the damage was done by hostile Indians, and the remainder by careless whites. Hundreds of square miles were burned over and immense damages were done to the timber. A painful evidence may be seen along the road leading from Georgetown into the Middle Park, which was until recently bordered by forests of great magnificence, but now there is nothing but many square miles of dead and decaying timber.

It is estimated by well-informed persons that fully one-third of all the timber accessible among the mountains in this State has been burned over and killed by fire within the last six years.

(30.) MONTANA.

Jefferson County.—Fires have occurred among the mountains, at different times during the year, but not of long duration. They were mostly set through the carelessness of parties encamping in the timber, and cutting wood and poles. No efforts were made to extinguish them, as they were remote from dwellings and hay lands. These fires did great

damage to the timber, but no estimate can be made, either as to the area burned or the value destroyed. Perhaps the only remedy would be in the enactment of a stringent law prohibiting all hunters, prospectors, wood and timber men, pleasure-seekers and others, from carrying any combustible materials among the mountains.—(*J. H. Fisk, Bedford, Mont.*)

Madison County.—In the early settlement here large tracts of timber were destroyed by fire through the carelessness of campers, and these fires were so frequent that the subject was brought before the legislature. A law was passed imposing a heavy fine upon any one convicted of willfully or carelessly setting fire, to the damage of the timber or grass, one-half of the fine to be paid to the informant. This law has had a salutary effect, and a fire of any consequence has not occurred to my knowledge since its enactment.—(*E. H. Combs, Laurin, Mont.*)

(31.) IDAHO.

Nez Perces County.—Forest fires are common in August and September, being usually started through carelessness and indifference. No efforts are made to check them except when they threaten individual property, and more than this would be useless. There are vast forests of young timber yearly destroyed by fire, but as these fires run in streaks an estimate of the area burned over would be impossible. Marks upon the timber lead me to believe that this whole country burns over about once every four years, not all at once, but in streaks here and there, as the dead grass of former years makes good fuel for the flames. The dense forests grow on the north slopes where the soil is damper, and the greenness of the grass protects them. It is quite impossible to estimate the value of this timber, if it could be preserved for future use; dollars cannot replace it. Much private property has been lost in these fires, and many have lost their lives. In all forests of this region there are strips of prairie. They are treeless on account of their naturally dry location, and on these the grass becomes dry while it is still green among the timber. If these were burned early the timber would be safe, and the spread of accidental fires would be prevented for probably two or three years, as these prairies will not burn oftener. I see no way to prevent the occurrence of these fires, except by extensively advertising or exhorting. Many new comers appear to be ignorant of the fact that these grasses will burn and I once knew a man who once burned many cords of his own wood while burning some brush from his way. He did not know that the grass would burn.—(*J. Brigham, Lidyville, Idaho.*)

(32.) UTAH.

Beaver County.—No extensive forest fires have happened during the year. They are set by Indian and perhaps white hunters to drive out deer, and commenced this year about the middle of September, continuing some ten days. Perhaps one or two miles were burned over, chiefly in the cañons of the mountains east of Beaver City and within plain view. There is very little standing or green timber remaining, and the main damage was done to dry poles such as are used for fencing, some of which were standing and some down. These fires usually occur at a considerable elevation, and upon lands not fit for agriculture. They do not usually spread very far, and the only remedy that can be proposed would be to prosecute such whites as are proved guilty; but

the evidence for this can rarely if ever be obtained. (*Daniel Tyler, Beaver City, Utah.*)

Kane County.—Our forests of timber suitable for sawing occur high up in the mountains, and the cost of making roads is considerable, amounting in some cases to thousands of dollars before reaching a place sufficient for a supply of from ten to fifteen years. A fire rarely occurs, except as set by Indians in hunting, and then it sometimes does a great deal of damage. In other cases the fires are of limited extent. None have occurred in the present year.—(*R. W. Reeve, Duncan's Retreat, Utah.*)

Wasatch County.—Last year (1879) was a very dry season and many forest fires occurred around the county, which burned up a great amount of timber, amounting to thousands of dollars in damage to the country. I suppose it was caused by miners prospecting for mineral, and making fires to cook by. These were left burning when they went away, and the wind rising would scatter the fires about. It has been supposed that miners have set fire to the timber to burn over the ground and thus afford a better chance for seeing the minerals.—(*John Cooke, Heber City, Utah.*)

Morgan County.—No destructive fires have happened this year, but in other years they have been very destructive to timber and fencing materials. Our climate is very dry, and during the months of August and September a small camp-fire left by prospectors for mines, or by woodchoppers, have spread for many miles. It seems impossible to prevent their recurrence, as men of this class are quite indifferent to the interests of the county, being only transient persons. It would be proper to enact a law making it a penal offense to leave camp-fires unextinguished during the dry season.—(*Saint Francis, Morgan, Utah.*)

Salt Lake County.—Fires occurred in the month of September, and continued about three weeks. They are supposed to have been set by Indians, and extended over a district about a mile square on the mountain sides in Salt Lake County, and half a mile square in Tooele County, doing damage estimated at \$30,000 to the standing timber, and \$1,500 to forest product prepared for market. In this dry and mountainous region no preventive measures can be devised, except increased watchfulness against the leaving of fires burning at camping places, and the exercise of some restraining or preventive influence upon the Indians.—(*J. McKnight, Salt Lake City, Utah.*)

Sevier County.—No fires have occurred in 1879-'80, but in former years it was common for the Indians to fire the timber to drive out the deer. This is not practiced now, as they are less numerous and begin to depend more upon farming than hunting. In passing through these mountains, it will be seen that great damages have been done by these fires above referred to.—(*W. Morrison, Richfield, Utah.*)

Tooele County.—Fires have not occurred in 1880, but in 1875 some damage was done. We have no wood except up among the mountains, in patches covering more or less ground in what are termed "forks in the cañons." These patches may average in the county from 50 to 500 acres, and when the fall season is very dry, fires started by camping parties and left smouldering on the ground, will sometimes spread rapidly and generally destroy all the timber within reach. The autumn of 1875 was very destructive to timber in this respect. But the worst enemies to growing timber are the railroad-tie cutters, and the work of destruction is going on so rapidly, and the supply is so limited in this county, that I feel safe in saying that in five years from the present time not a tree 6 inches in diameter will be found in the county. On

the other hand, the numerous coal-kilns will have swallowed up all the dry timber, and the settlers will reap the bitter fruit of their improvidence and wastefulness.—(*Peter A. Droubay, Erda, Utah.*)

In several other counties no forest fires had occurred during the past year.

(33.) NEW MEXICO.

Colfax County.—We have no forests in this portion of the West, excepting such timber thickets as occur in the mountains, and among these fires will sometimes appear more or less every year. They have been formerly charged to the Indians, and are yet. They are most apt to begin in the fall, and sometimes last for weeks. The Indians have been mostly removed to reservations, except a few stragglers who come back to hunt, but still these fires will rage and we cannot tell how they originate. As they occur on the mountain sides and cañons nothing could be done to prevent their spreading, and they burn till they go out of themselves, after burning all the timber, or until put out by the rains. They spread over a few miles square every year, and destroy much timber that in time would be valuable, although it is not yet accessible and is not of present value. As for preventive measures there can be nothing done unless possibly in the way of restrictive legislation, but in most cases it would be quite impossible to get at the facts.—(*M. W. Mills, Cimarron, N. Mex.*)

Dona Ana County.—No fires have come to knowledge within the last year. In the southeastern portion of New Mexico, in the Sacramento and Guadalupe ranges, there are large bodies of timber, but it is a *terra incognita*, and seldom visited by a white man. During my residence in Southern California, I have known fires to originate from lightning, and sometimes by friction matches dropped carelessly upon the plains and ignited by stock. They are oftener started through the carelessness of campers, or by hunters in shooting upon the dry stubble fields.—(*T. Casad, Mesilla, N. Mex.*)

Mora County.—Fires appeared in the latter part of May and continued until the middle of July, having been started by the carelessness of herders, and by roving bands of Indians. No efforts are ever made to extinguish them, as they are remote from settlements. Probably 1,000 acres have been burned over in Mora County, and railroad ties to the value of \$1,000 have been burned.

San Miguel County.—Fires occurred in this county in May and burned till July, when they were extinguished by the rains. They generally are started from camp-fires, and sometimes from sparks of locomotives, and perhaps a hundred thousand acres or more were burned over. There appears to be no remedy for these fires, except in great care of fires in a dry time.—(*J. B. Whitmore, Gallinas Springs, N. Mex.*)

——— *County.*—Fires began in May, 1880, and burned for weeks, overrunning a portion of Socorro, Doña Ana, and a large part of Grant Counties, and extended into Arizona. The area was large, but cannot be estimated. These fires were supposed to have been started by Indians with hostile intent.—(———, Hillsborough, N. Mex.)

Socorro County.—Fires occurred in the mountains about June 1, and lasted a month. They were started by Apache Indians and extended for 20 miles, destroying much grass and timber. It is supposed that the fires were started to burn the grass, and thus prevent the troops from subsisting their horses.—(*John H. McCutchers, Socorro, N. Mex.*)

(34.) CALIFORNIA.

Calaveras County.—About 1,000 acres were burned off through carelessness about the middle of June in this county. The damage may be estimated at \$1,000, mostly in small timber and pasturages. Perhaps the best remedy against these fires would be a law imposing heavy penalties and imprisonment for carelessness, and a general trespass law against hunters. Fires have not occurred in the pine timbers of this county as frequently of late as formerly, owing to the increase of settlement and cultivation.

Fresno County.—A number of fires have occurred during the year, but none very destructive. They occurred in September, and the first part of October, and usually were set by sheep owners to improve the pasturage, or by Indians gathering pine nuts. No care is ever taken to check these fires, and they sometimes spread over considerable areas. The best remedy is private ownership. There is a considerable amount of timber and grazing land in the county, but the timber suffers more from the sheep than from fires, as they destroy everything under from five to eight years old, and they should be prohibited from running at large, for at least ten consecutive years out of every fifty.—(*C. D. Davis*, Fresno County.)

Lake County.—Several fires occurred between May and October, through the carelessness of campers, burning over perhaps 10 square miles. If the timber had been near a market it would have been worth perhaps half a million of dollars, but as it is so far back it was nearly valueless—say worth \$1,000. Some damage was also done to prepared forest products, and to fencing. The remedy appears to depend upon stringent laws against careless camp fires.—(*E. C. Parker*, Gravelly Valley, Cal.)

Mendocino County.—Considerable fires occurred from the middle of September to the 1st of November, but not doing great damage. They were set partly through carelessness of hunters and others, and partly intentional, and were allowed to burn till they went out. The injury to standing timber was nominal; to prepared forest products, probably \$2,000, and perhaps \$3,000 to \$4,000 to the dry grass, which is the dependence for feed until the return of fall rains. The lumbermen in the redwood belt annually set fires to clean out the limbs, tops, bark, and broken trees and their splints, as well as to keep down the undergrowth. The growing timber is seldom damaged, but the practice is very wasteful, for all shivered, checked, or otherwise imperfect logs are burned up. In the grazing belt fires are often started to burn the dense chaparral of the hills, and in both cases parties are usually prepared, and the damage is nominal, and more from the burning of the dry feed than any other.—(*G. McCowen*, Ukiah, Cal.)

Mariposa County.—Several forest fires occurred in this county, which burned for several miles, and destroyed to a great extent the standing pine timber.—(*W. A. Grade*, Hopeton, Cal.)

Plumas County.—Forest fires occurred to limited extent from about the middle of August to the 1st of October, caused by the carelessness of Indians, and may have burned over 10,000 acres in three several places. About a fourth part of the timber within the burned area was killed.—(*M. Ball*, Greenville, Cal.)

Solano County.—I have observed no fires this year, but have often seen them in past years. They usually occur in autumn, and probably in nine cases in ten, from the carelessness of campers and hunters, who leave their fires burning; generally nothing is done to stop them.

There is very little timber of value where they occur, which is along the Coast Range, bordering Solano County on the west. These are but sparsely timbered, and are mostly covered with what is here called "chenise brush." No means exist for reporting the areas burned in this, Napa, and Solano Counties in former years. They occurred in a rough country with few inhabitants, and in a region where there is little or no timber of value.

Fires seldom start on land owned by individuals, but generally on the public lands. If it were a penal offense for campers and hunters to leave camp without extinguishing their fires, or if it were forbidden under penalties to make fires on the public lands and allow them to spread, it would undoubtedly make them less frequent.—(*I. M. Dudley, Dixon, Cal.*)

San Diego County.—There are no dense forests in this county, and these are oak, sycamore, and willow, and so scattering that forest fires cannot occur. The fires sometimes spread from brush heaps, causing some loss to ranches and pasturages, and with some loss to trees.—(*D. A. Hollister, San Diego, Cal.*)

San Luis Obispo County.—In this county we have a very limited amount of timber, and in fact nothing worthy of the name of forests. Some two or three localities, with an area of say 5,000 acres each, have pitch pine, which grows very sparsely, and fires have gone through them at times, but not to damage more than the feed and grass. One-half of this pine has been converted into lumber, the best being selected, leaving the balance few and far between. Our mountain tops and ravines are generally covered with scattering oak, sycamore, &c., and I know of no instance where any serious damage has been done by fire. On the eastern slope of the Coast Range there is a considerable amount of white oak, but it does not grow very dense, and the vegetation being always sparse there is nothing to feed a fire or carry it to the timber.—(*P. A. —, San Luis Obispo, Cal.*)

Siskiyou County.—We have fires in the mountains every year, generally started through the carelessness of hunters and travelers. They are allowed to burn for months, or till the fall rains extinguish them. They sometimes run a distance of ten miles here and there across the summits, and we may at times see three or four fires at a time after the 1st of August. There is very little attention paid to them, unless they endanger the farms bordering the valley. The timber burned is of no present value; it might be to future generations. We have a law upon the subject of setting forest fires, but it has no effect upon careless hunters and excursionists.—(*W. J. Root, Siskiyou, Cal.*)

Stanislaus County.—In the fall of 1879 about 5,000 acres among the foot-hills in the eastern end of this county were burned from the carelessness of campers. The progress of the fires was opposed with wet sacks and by cutting down trees. The fires continued ten days.—(*G. M. Booth, Oakdale, Cal.*)

Tuolumne County.—No fires have occurred the present year in this county, but in previous years they have originated from the gun-wads of hunters and from camp-fires, but by whom is seldom known. There can, perhaps, be no means devised for stopping these fires except fine and imprisonment, when the parties are detected.—(*L. W. Irving, Columbia, Cal.*)

From eleven other counties in California reports were received informing that no fires had occurred during the past year. In several of these there are no forests, and fires, when they occur, are chiefly injurious to the pasturage.

San Mateo County.—Fires began about the 1st of November, 1880, and raged for three weeks. There were intervals when they seemed to be almost subdued, when they would gain force in some other point not so well protected. They overran a district 10 miles long and 5 miles wide and are said to have been started from neglected camp-fires, or as some think, from the burning of a tree that had fallen across the road. The means employed for checking them were, beating out the fires with sacks, dragging large branches of trees with horses along the edge of the fires, and plowing wherever the soil allowed. The damages could hardly be estimated, but were at least \$80,000, whereof \$35,000 was to standing timber, \$25,000 to wood, posts, rails, and shingles, and \$20,000 to buildings, fences, and grain. As a preventive, we would recommend stringent laws, forbidding the lighting of fires on inclosed lands, or shooting on such lands with wads that could burn, and requiring under heavy penalties that all camp-fires should be extinguished before leaving them. Habitual caution and care can alone secure us from these dangers.—(*Joseph S. Wallis, Mayfield, Cal.*)

(35.) OREGON.

Clackamas County.—Fires occurred in September, 1880, from causes unknown, but probably from the carelessness of hunters, and burned until they were extinguished by rains. About 500 acres, owned by the Oswego Iron Company, were burned over, the underbrush only being consumed. There were no fires in the coal jobs. It is suggested, as a precaution, that farmers should be required to notify their neighbors when they are about to set fires, and that they shall be held liable for the damage that may result from their carelessness. There should also be a law requiring all hunting and fishing parties and campers, to extinguish their fires before leaving them, under penalties of fine and imprisonment for carelessness.—(———, Oswego Precinct, Oreg.)

Fires began about the 1st of August, and continued six weeks, having been set by the settlers to clear the country of brush so as to improve the range for cattle. They burned over an area of 100 square miles, in a district where there was much fallen timber caused by a great storm January 9, 1880, remote from farms and roads. These fires did not run among standing timber, and but little other property was destroyed. The best preventive against fires is a State law, which is generally respected, and for the interest of the people. Besides this, the climate has so changed since settlement began that a forest fire has been almost unknown during the last fifteen years.

When I came to this country in 1846 it was almost perfect in all its wildness. With a few exceptions, not a tree or a shrub had been touched by the hand of man. Thousands of wild Indians roved over the prairies, or hunted game in the almost impenetrable forests. No fires had run in these forests for hundreds of years, the Indians being careful not to let fire get out, lest the grass should be burned from their horses, of which they had thousands, or lest the game should be driven from the forest in their section of the country. Large trees, 3 or 4 feet in diameter, stood in these forests, with the accumulated debris of hundreds of years lying thick around their base, with not a sign of fire about them. But early in the summer of 1847, when the immigrants, who had set out to seek homesteads for themselves began to arrive, fires got started in the forests, and the summer being dry they burned through the whole summer. Millions of acres of as fine forest timber as can be found on

earth to-day were burned over and killed. Whole forests of red and yellow fir, of the giant arbor-vitae and of hemlock and tamarack were destroyed by these raging fires. The smoke was so thick that we could scarcely see the sun at midday, and people complained of sore eyes and oppressed breathing. The ashes carried by the winds became a nuisance in and about our houses. But at length the fall rains came, put out the fires and drove away the smoke, so that the people could breath freely again, and get a view of the country, and of the ruins of the forests which had been her greatest boast. A million of dollars would not repair the damages done by fire during that season.

For a few years subsequent to the great forest fires of 1847 our climate was dry and crops were uniformly good. But when this vast burnt area became covered with a thick growth of young timber, our climate seemed to change for the worse. The rains continued later in the spring, and began earlier in the fall. After this our wheat became affected with smut and rust, and was shriveled to some extent by the humid heat of summer, circumstances before unknown in this country; and it is probable that it is on account of this increased humidity, and change of climate, that we have had no forest fires to speak of, during the last fifteen years, the ground and underbrush in the forests, in many places remaining damp the whole summer through. But a few dry years in succession would give us forest fires again, and perhaps better crops.

On the 9th of January, 1880, the gale which swept over this coast, destroyed much standing timber, over an area some 300 miles long by 100 wide, and it was this timber that the settlers tried to burn off during the last summer. But owing, doubtless, to the late dampness of the climate, the fires would only run where the timber lay the thickest.—(*William Phillips*, Clackamas, Oreg.)

Clatsop County.—Forest fires have been common on this coast since 1841. One occurred on the 1st of September of that year, and every year there have been more or less fires, started by Indians and camping parties, and in early times purposely set to clear land. No means are employed to stop these fires except in some instances back-firing, which has only been practiced in recent years. The most extensive fires that have happened, extended along the north bank of the Columbia River, below the Cascade Mountains, and from 8 to 10 miles wide. The year is not certainly remembered, but I think it was in September 1850. I well recollect the grandeur of the illumination, as seen in passing up and down the river, in the dense smoke at the time. For a distance of 50 miles or more, the forests were overrun and many millions of dollars worth of timber were burned, that lay convenient for shipping, and of size best for handling and working into lumber. There should be a law imposing as a penalty, imprisonment at hard labor for a term of years, for setting these fires. Fines would not reach them, as the people who set them have generally no property, or at most nothing but a cabin that may have cost three days' labor. He sets fires to burn what is called a "slashing," that is, timber and brush fell in any way that happens, and allowed to lay from three to six months, until a dry time, when it is set on fire as it lays all over the ground, without any regard to other timber, or the rights of others, or their improvements. These slashing fires are set every year, and from ten to a hundred thousand acres are burned over yearly.—(*W. H. Gray*, Olney, Oreg.)

Columbia County.—Fires appear about the middle of July and lasted about six weeks. They originated in the burning of slashings, and were purposely set to clear them off. Hundreds, if not thousands of

acres in this county were burned over, and this remark will apply to the greater part of Western Oregon. Much valuable timber, especially cedar and yellow fir were burned. This is a heavily timbered country, consisting in part of cedar, yellow and white fir, hemlock, maple and ash, as fine a body of timber as on this coast, or in the world. Except on the Columbia River, or other water-courses, where it can be marketed, it has no value, and we burn it up to get rid of it for farming purposes.—(*H. A. Guild, Vernonio, Oreg.*)

Douglas County.—We have had no fires of consequence during the last year. As a means of prevention, I would suggest a heavy fine for setting out fires in the dry season. It is almost impossible to limit the spread of these fires, after they once get started in the forests on this coast. There are large districts in this county where the forests have been consumed by fire in former years, embracing many thousand acres of once valuable timber land, but there are no data for reporting facts with accuracy, as the county is very large, extending 150 miles from east to west, and 90 miles from north to south. The burned districts are mostly unsurveyed, and no records are obtainable by which one could get anything reliable, either in regard to the number of acres burned, or the value thereof; but I have no doubt, if the actual damage could be ascertained, it would run up into the millions.

I am glad to see the department take hold of this matter. There are hundreds of fires started in the forests on this coast, for the purpose of destroying the timber, so as to make stock range, whereas, in a few years the timber would be of a great deal more value than all the stock which these ranges can ever support. There is a class of people on this coast that are desirous of obtaining everything for themselves. They appear to have no thoughts as to what future generations are to do for the want of that which is now needlessly destroyed.

As to limiting the spread of fires on this coast, I think it is impossible, after they once get started, as the timber is so full of resin that it burns like a dry tar barrel. A great many of our forest trees, if a match is ignited at the foot, will take fire and the flame will run up from 100 to 200 feet in a few seconds, and if there is a wind, as there generally is, the fire spreads very rapidly.—(*Thomas Smith, Wilbur, Oreg.*)

Josephine County.—No destructive forest fires have occurred in this district during the past year, but they have sometimes been very destructive.—(*H. Woodcock, Kerby, Oreg.*)

Lane County.—Fires occurred about midsummer, and lasted till the rains came. They were probably started from camp fires, and from the clearing of land, and when once under way, little can be done. They are usually of not great extent, but there was damage done to timber, forest products, and other property to a considerable extent. These fires occur every summer, and it seems impossible to prevent them. They are always the result of carelessness rather than of recklessness, and quite often they are started by fires kindled by emigrants and others, and left burning when they go away. The smoke of these fires is so dense that in some years—at least twice within the last twelve—we have been obliged to light lamps in the day-time.—(*H. Elsworth, Eugene City, Oreg.*)

Multnomah County.—There have been extensive fires during the last year, which began in August and lasted about four weeks. They were set by careless men, and continued until extinguished by the rain. A large area was burned over in this and other counties, and a great deal of damage was done to standing timber. There can scarcely be any means devised for preventing these fires, as a great deal of brush is

slashed every summer, and the wind scatters the fires in every direction.—(*G. H. Zimmerman*, Portland, Oreg.)

Polk County.—Thirty-five or forty years ago most of the heavy timber on the coast mountains in Polk and Benton Counties was destroyed by fire. The climate is so damp that only at long intervals are the conditions favorable for forest fires.—(——— ———, Buena Vista, Oreg.)

County.—No destructive fires have occurred the present year in any part of the valley within my knowledge, but several years ago fires did a vast amount of damage along the coast range of mountains. There are, however, no means of ascertaining the area burned over, or the amount of value consumed. The greatest damage to forests in this country is far back in the mountains, where the hunters carelessly let the fires get away from their camps. These fires do an immense damage, for the forests are the finest in the country. So long as the country remains unsettled, I can see no means for preventing lawless men from starting these fires.—(*G. F. Crawford*, Albany, Oreg.)

Yam Hill County.—More or less of forest fires occur in the coast mountains every year, usually beginning about the 1st of August, and continuing two or three weeks. They are started by persons passing to and fro, and from camp-fires and carelessness. When a fire once gets started in the mountains it is useless to try to put it out, as well as very dangerous. They will burn until they go out of themselves, or until they are extinguished by the rain, and frequently run ten or twenty miles, killing the green timbers and burning up all that is dead and dry. Tillamook County is subject to these fires almost every year. They have very severe fires down on the sound and along the Columbia River, these parts being a very heavily timbered country. From the absence of statistics the extent and damage of these fires cannot be given, but in some years they are very heavy and destructive.

Within the year past standing timber to the value of \$5,000 must have been burned in this county and in Tillamook. Down on the Columbia River there was much injury done to farms lying adjacent to the timber. The heaviest fires occur over in Washington Territory, and the smoke blown from thence southward, in the summer season, darkens the sun, so that sometimes it is necessary to light candles to see at dinner. I can think of but one means for preventing these fires, and that is by legislation. If a law were in force making it a penitentiary offense for people who are traveling and camping out to leave fires without putting them out, this might prove an effectual remedy. People are very careless—the climate is hot and dry, and with a strong wind the fires may do a vast amount of damage.—(*D. O. Durham*, McMinnville, Oreg.)

(36.) WASHINGTON TERRITORY.

Clarke County.—Destructive fires always occur in the fall, when everything is dry, and are generally started in the clearing up of land. No means of control can be used when they are once kindled. From 10,000 to 20,000 acres have been burned over the present season, and I would think the latter estimate not too much. The injury to standing timber might be \$5,000, and to forest products \$500. Fences and crops were burned to the value of at least \$500. It scarcely seems possible to prevent these fires, as settlers must set fires in clearing up their lands, and if the wind during the dry season should begin to blow from the east no human power could prevent them from spreading, and as long as the wind blows the fires will burn more and more fiercely. I can

suggest no means by which fires can be prevented or avoided. Large bodies of timber have been entirely destroyed in former years, as can be seen all over the county.—(*J. A. Kerns, Washongal, Wash.*)

King County.—Forest fires have not been as extensive this year as usual. They commenced about the middle of August and lasted about a month. They generally come from fires set by farmers in clearing land, and by Indians and others. No effort is made to prevent them from running, and they do not generally destroy large timber. Nearly every year fires run in places through the forests, burning the dry and rotten wood on the ground and the small brush, but the bark being from two to five inches thick on the fir-timber, but little damage is done. Probably about one-twentieth of the country is burned over every year in this region. Probably but little damage was done this year, but occasionally in a belt of timber the large trees take fire, and then the fire sweeps everything before it. These remarks will apply to the whole Puget Sound Valley, about 100 miles wide by 150 miles long. Penal laws might perhaps prevent setting these fires, but nothing will arrest their spread.—(*John J. McGilvra, Seattle, Wash.*)

Thurston County.—Fires occurred from July to the 20th of September, being generally set by Indians and whites, and spread over a third of this county. The damage to standing timber was not very great, as the timber is very tall and the bark very thick. A considerable amount of cord-wood and bark was burned, and some barns. I think it is impossible to prevent forest fires in this county, as this is the only way in which we can ever subdue the timber and brush land for cultivation.—(*John Chipman, Olympia, Wash.*)

Wahkiakum County.—There have been no fires this year. They generally come from the clearing of land, and there are no means of arresting them when once started and spreading in the standing timber, when they will burn till stopped by the rain. There has been no damage from fire in this county since 1878, when the damage to standing timber was very little, the most of the land burned over being worked off. In some places the fire worked in a little, destroying the spruce, the bark of which is very thin. The fir is of a more hardy nature, and was little injured. We have so much rain in this region that it seldom gets dry enough for fires to spread. The loss in 1878 was perhaps \$2,000.—(*Thomas Kent, Cathlamet, Wash.*)

(b.) *Summary of Opinions as to the Origin of Forest Fires.*

Correspondents, in reporting the causes that originate forest fires, must necessarily depend upon their opinions rather than upon certain knowledge; for in a great majority of cases the origin of these fires is to them unknown. They may have received their information from hearsay, and these rumors may have been purposely started in the wrong direction by the parties really guilty of the wrong to divert public indignation or avoid legal consequences.

Giving to each assigned or supposed cause an equal credit, the summary, in numerical form, is as follows:

| | |
|---|-----|
| Natural causes—lightning | 3 |
| The direct or incidental act of man | 464 |

Of the latter, the Indians are charged as the originators in 21 cases, the remainder being ascribed to civilized man. The motive with the former is supposed in most cases to have been hostility to the whites, and a desire to harm them as much as possible. It will be remembered

that these returns often refer back to a still recent period of Indian hostilities in Colorado, New Mexico, and the northern tier of Territories. In a very few cases their custom of burning to drive game, &c., is mentioned; while on the other hand, in Oregon, they are mentioned as having formerly scrupulously careful in the use of fires, least the feed for their horses should be destroyed, and that so long as they remained sole occupants of the country forest fires were unknown.

The 443 cases for which the white man is directly or indirectly held accountable may be classified as follows:

INTENTIONAL:

| | |
|--|----|
| <i>For improvement of pasturage</i> , by clearing off dead grass and weeds, so as to improve the range for farm stock, or in some instances to clear away forests in order to open the country for pasturage (chiefly in the Southern States and on the Pacific coast) | 85 |
| <i>Incendiary and malicious firing</i> | 37 |
| <i>"Tramps"</i> (perhaps through carelessness in some cases) | 6 |
| <i>Back firing</i> , set to destroy combustible material in front of an advancing fire, and escaping beyond control | 3 |
| <i>Clearing the ground for finding chestnuts</i> | 5 |
| <i>Clearing the ground for finding mica</i> | 1 |

ACCIDENTAL:

| | |
|--|----|
| <i>Clearings</i> : The fire escaping from brush-heaps, "slashings," or fallows, in preparing the soil for cultivation, according to customs more or less censurable but sanctioned by usage | 93 |
| <i>Hunting</i> : Usually from careless neglect of camp-fires; sometimes from gun-wads, and in other cases to drive out game, or to destroy the dead leaves so that game may be approached in silence | 75 |
| <i>Carelessness</i> in the use of fires by travelers, emigrants, explorers, pleasure parties, &c. who thoughtlessly leave burning fires | 69 |
| <i>Locomotive sparks</i> | 55 |
| <i>Charcoal burning</i> | 11 |
| <i>Smoking</i> , by throwing down burning matches, or cigars, &c. | 0 |
| <i>Steam mills</i> | 2 |
| <i>Burning oil-well</i> | 1 |

Reducing these numbers to percentages, we find of the whole number 0.0063 ascribed to natural causes, and 0.04 to the Indians.

Of the 439 ascribed to the white man, 30.3 are due to intention, and 69.7 to carelessness, the greater part being avoidable, and if not in the starting of the fires, to a great degree in the provision that might previously be made for their suppression.

The estimates of damages are altogether too indefinite for summary, being founded upon very uncertain information, and very seldom upon exact appraisal. They very generally refer to the injury done to young timber, the value of which is mostly prospective, and which might have far exceeded any estimates that could now be formed from present prices had it been allowed to grow to full maturity. In fact we would consider any attempt to obtain a numerical summary of the annual destruction resulting from forest fires, through any existing agency as liable to great error, for it would necessarily be founded upon personal estimates, which would sometimes be exaggerated, from their overwhelming local importance in the immediate presence of the observer, and in other cases immensely undervalued, from their being in remote and inaccessible regions, where the only data for estimate might be a column of smoke on a distant horizon, or the vague rumors of hearsay.

4. CANADIAN FOREST FIRES.

(a.) *Their Frequency and Extent.*

Forest fires in Canada have at various times overrun large areas and done immense damages. It is not unusual to find noticed in the pub-

lished reports of surveys extensive tracts as burned over, the traces of fire still being visible among the trees still remaining, or the effects upon the soil.

During the year 1880, extensive fires occurred north of the Lower Saint Lawrence, and in the eastern townships to the south of that river, the former having occurred about the 1st of July, lasting two weeks, and the latter in the early part of September. In both instances they originated in the carelessness of settlers, and both continued until stopped by heavy rains. In the Saguenay region, the fires spread over an area of about twenty and in the eastern townships over about sixty square miles. There are no data for estimating the damage done to standing timber or other property. In Drummond County, the latter included houses, barns, and agricultural produce. As a measure for preventing and controlling these fires, an official correspondent suggests the employment of a sufficient number of wood-rangers in wild and wooded lands, and a strict enforcement of the law in settled and partly settled districts, regulating the time at which the burning of stumps and refuse of clearings is allowed.

(b.) *Report of an Investigating Commission.*

In a "Report on Forestry and Forests of Canada," by the Hon. H. G. Joy, a member of the Dominion Council of Agriculture, the causes of the impoverishment of the forests of that country were considered, and such remedies were proposed as seemed possible to apply. The great cause of this impoverishment, deprivation, and waste was *fire*, and of this he speaks as follows:

We can cope with waste and pillage in our forests, they are but the work of man, but we are terribly helpless against fire. It is in every country the greatest enemy of the forest, especially the pine forest, on account of its resinous and inflammable nature. It is ubiquitous; you find it exercising its ravages wherever nature has planted its grand virgin forests; in North America destroying the beautiful white pine, and at the antipodes, in New Zealand, sweeping away the noble kawrie pine; through India, the Russian Empire, Sweden, and Norway it throws around the globe a girdle of lurid flames, only broken by the great oceans.

It is estimated by those who are most competent to form an opinion on the subject, that *more pine timber has been destroyed by fire than has been cut down and taken out by the husbandman*; not only is the large ripe pine timber destroyed by fire, but all the young trees too, upon whose growth we must depend for the restocking of our forests. It is not practicable, in our Canadian woods, to plant trees to take the place of those that are cut down.

The difficulty of guarding against fire in such immense and distant forests as ours is enormous, and as for extinguishing it when once fairly started, *the power of man cannot do that*. It will sweep onward as long as it can find food, leaping at one bound like a giant over such rivers as the great Ottawa and Miramichi, and will only stop when brought to bay by large lakes, or when it reaches rocky or barren ground with nothing to burn. It will riot for weeks, until starved for want of food, or drowned under torrents of long-expected rain.

(c.) *Reference to Methods employed in Europe.*

In France and Germany, where the science of forestry is brought to a high state of perfection, where the forests are much smaller than ours, divided and isolated one from another, kept as much as possible free from rubbish and dead timber and all the light stuff that carries on the flames so rapidly, protected by stringent laws, strictly enforced for generations: watched over by large staffs of foresters; even there disastrous fires are of frequent occurrence, and they call for such an effort to suppress them as is totally beyond our power, as the following example will show:

Considerable pine forests have been created within the last two or three generations in the southwest of France, and now cover large regions that were once barren heaps of sand rolled up far inland by the action of the sea. Those forests, created by man, now yield a large and ever-increasing revenue, are highly valued, and must be pro-

ted, one would think, as well as any forest can ever hope to be protected. Nevertheless, fires are frequent among them.

The people do there what we cannot do here, and generally conquer the fires, with more or less loss. But a short description of their mode of warfare will show how utterly inapplicable it is to our circumstances, and make us feel, more than ever, that *our only hope is in PREVENTION*.

In France, as soon as it is discovered that the forest is on fire, (which cannot take long, where the forests are comparatively small, and the country *thickly settled* all around), the church bells ring in all the neighboring villages, the whole population, trained by long practice, turns out, with axes, spades, shovels, rakes, &c., under the guidance of acknowledged leaders. They combine their movements according to the direction of the wind and other circumstances, and dispose their forces with intelligence and promptitude. A mode often resorted to, is the *contre feu*, fighting the fire with fire, something not unlike what the hunters practice when overtaken by fires in our western prairies. Knowing the forest well, they direct their forces to one of the *coupe-feus* or *safety-strips* (upon which no trees or shrubs are allowed to grow) or to the most favorable spot on the path of the fire, at a sufficient distance ahead of it, form an extended line of workers wider than the fire, and set to work to remove as much of the inflammable materials as possible; they cut down and burn, and trample, and shovel earth, and carry away stuff, &c., and when the fire, in its course, reaches that spot, it finds little food, hesitates, lingers, and at last is generally conquered.

We cannot do that. Our forests are not surrounded by villages, the alarm bells cannot muster crowds of willing workers to our distant wilderness, often hundreds of miles away from man's dwellings.

But, if we cannot stop the fire, can we not do something to prevent it, and to limit its ravages? The best means adopted in Germany and France, and in Great Britain too (where the science of forestry is becoming an object of serious study) for preventing the spreading of the fire over a large extent of the ground, is the laying out of their forests, and dividing them into isolated independent blocks, by means of the *safety-strips* or *coupe-feus*. But even there, whenever the wind is very strong, it has been found that it would often carry inflammable matters, such as pine cones, clear over everything, to a distance of one and even two miles and start fresh fires, where they fall, which will be readily believed by those who remember how easily fires have swept over the Ottawa River.

Though not always sufficient, those safety-strips are, nevertheless, of great service, but their opening is scarcely practicable with us. It would entail incredible cost and expenditure, on account of the great length we would have to prolong them, and the distance, and because, furthermore, the brush and timber felled down to make them, would have to be removed, otherwise it would soon dry up and increase the danger, instead of decreasing it. Then, to maintain their efficiency, they would have to be kept clear of a new growth. We cannot think of undertaking such a gigantic work, at least in our large and remote forests. Neither can we undertake, as they do in Europe, to clear the underbrush and to remove the dead wood and rubbish; it is an excellent precaution, and its adoption in Europe is not only free from cost, but even brings a large profit. Our circumstances are totally different, as every man of any experience must know, and I will not enlarge upon that point.

If we cannot profit by those good examples, we are nevertheless not going to sit down tamely and declare that nothing can be done. *We can do a great deal to prevent our forests being set on fire.*

These fires are started by settlers clearing their lands; by lumbermen while driving their timber down the stream; by hunters and fishermen; by sparks from locomotives by lightning; sometimes, even, by the violent rubbing of dead branches one against another in gales of wind.

We cannot very easily provide against the latter cause, as we cannot remove all our dead wood, and we cannot provide against lightning in the forests. But locomotives can keep down their sparks, with screens over their smoke-stacks. The railway companies are interested in every way in guarding against fires, and if they neglect to take sufficient precaution, they can be reached and called to account.

(d.) *Fires by Settlers.*

A frequent cause of disastrous fires in the woods is the mode of clearing land now generally followed by settlers. Of course, they must have recourse to fires in order to clear woodlands, *but fire ought to be our servant, kept under continued control, not our master.*

Woodland can be cleared with comparatively little danger from fire, and be made ready to sow earlier than by the mode now generally in use (as I know from practical experience), if the settlers will only burn the shrubs, branches, leaves, and tops at once, as they cut them down. Light a good bright fire to start with, after having made a

safe place for it, and then begin cutting away, and as you cut throw upon the fire at once; children will help immensely with the light stuff, and willingly too. The fire once well started, everything will burn up, the green wood with the sap running out, and the green leaves too, not only those of fir trees, but of every hard-wood tree. As you throw in the branches the whole of the green leaves upon them catch fire simultaneously, with a sudden flash, and burn up with a crackling sound as if they had been steeped in grease.

I have often done it, frequently in wet weather. We get rid immediately of all the light inflammable material, from which the greatest danger of bush-fires is to be apprehended; the larger branches and trunks of trees, if you must burn them (which you ought not) present little danger of fire in dealing with them. When you get inconveniently distant from your first fire, you light a second one, and let your first one burn out. It is remarkable that those fires generally burn down to the ground more thoroughly than the carefully constructed piles that have been drying up for a whole year.

Increased safety from fires is not the only advantage that would accrue to the settlers from the adoption of this mode of clearing woodlands. Take them as a whole, for the sake of comparing them, and this mode does not give more work than that now in use. True, you have got to convey the stuff you intend burning a little further, because one single fire, continued and replenished for some hours, will dispose of as much stuff as would have made one or two dozen average piles, but then, think of the advantage of having got all that rubbish out of the way at once, instead of having it to cumber the ground until next year, when perhaps the season will be too rainy for burning, or so dry that you will run the risk of setting fire to your own farm and the whole surrounding country. As the work is now done, even in a small clearing, no settler can keep all his fires under absolute control; he is obliged to wait for dry weather, and then he has got twenty, thirty, and more fires going on at once. A sudden gust of wind, which is often produced by the intensity of the fire itself in the stillest weather, and off the fire goes, reaches the woods close by, and meets there with such encouragement as to get very soon beyond human control.

As a further precaution against the danger to the forest arising from the clearing of lands by fire, I would recommend that the government should confine the settlements as much as possible to the hard-wood lands, of which there are large tracts still available. "As a general rule" (to quote the words of Mr. Allan Gilmour in answer to questions of a committee of the House of Assembly of Quebec) "it is well known that they are of much better quality for farming purposes than those covered to any great extent with pine, while they are at the same time much more easily cleared, and will give, as a first crop, a good return, in the shape of pot or pearl ashes from the burnt timber, should the parties clearing the land choose to make them—a benefit which cannot be had from pine burnt in the process of clearing."

(e.) *Comparative Immunity of Hard-wood Timber Lands.*

"In settling the hard-wood lands, there is also the important fact to be considered, that fires do not spread through them to anything like the same extent as where pine chiefly prevails; and, indeed, from a very extensive observation, I am of opinion that fires have little disposition to spread in the former, while the reverse is the case with the latter."

To show how generally it is acknowledged, among practical men, that hard-wood forests enjoy a greater immunity from fire than pine and other coniferous forests, I will select one striking case out of many. In Hanover (where the science of forestry approaches nearer to perfection than in any other part of Germany), where railways pass through fir forests, and it is feared that the sparks flying from the locomotives may light the accumulated fir leaves, dry heather, and other smaller plants, it is customary to guard against this danger by means of safety strips, formed by other kinds of trees, not coniferous, that are planted along the line of railway, as for instance birch, coppice woods of oak, &c.

(f.) *Recommendations for Prevention of Forest Fires.*

Before concluding this part of the question, viz, bush-fires lighted by settlers, in clearing the lands, I would recommend:

1st. Such a study of the soil of our unsettled lands as would enable them to be classified under two distinct heads—lands fit for agriculture, to which the settlers ought to be sent, and lands unfit for agriculture, from which the settlers ought to be kept away, for their own sake, as well as for the public good.

2d. Legislation for the purpose of increasing the powers of municipal councils and enabling them to compel the adoption of every precaution which they may deem necessary, to reduce the danger of bush-fires in the clearing of land, and to impose severe pen-

alties in case of neglect. To that increase of power ought to be added an increase of responsibility for neglect of duty, which would make the municipal authorities more watchful, and prepare the people for a more strict enforcement of regulations.

3d. In new settlements not yet ripe for the municipal, the government's regulations would have to be enforced by wood rangers; as the season for *burning* is not a long one, and is often shortened by rains, the period during which the government officials would have to exercise their vigilance in relation to this matter is not a long one.

The Province of Quebec is in advance not only of all the other provinces of the Dominion, but of the United States too (see last report of the Secretary of the Interior), in passing a law for the protection of the public forests against fire.¹

It contains some very good provisions which would be of great benefit were they carried into effect, which would entail greater sacrifices than the province has been hitherto willing to make, though not greater than the magnitude of the interests at stake require.

(f.) *Fires by Lumbermen, Hunters, and Fishermen.*

The origin of many fires has been traced to them, but in no case have I heard of any evil intent on their part, to do harm; it is through thoughtlessness, and they must be educated to prudence.

Nothing is so striking as the contrast between an European, the first time he sets foot in our forests, and a Canadian, familiar with the woods; the feeling, amounting to actual veneration, with which the European will look at our boundless forest, the melancholy glance at the fallen tree, the sigh over the dead timber rotting where it fell, the fierce denunciation of the great waste, and especially the reluctance at leaving behind him the smallest fire before it is thoroughly extinguished; on the other side, the naturally complete indifference of the Canadian, not only to the scenes with which he is familiar, but especially to the danger of fire.

However difficult, or next to impossible, it would be to prevent the work of the incendiary, it is not impossible to force prudence upon the careless and to open the eyes of the inexperienced. It will entail a much larger expenditure than is now incurred, as the number of forest rangers must, of necessity be considerably increased; but if it is true that so much timber is destroyed by fire (and no one will deny that the losses are enormous, however difficult it may be to compute the amount), is it not worth while protecting our forests from that danger by devoting to such purpose a reasonable share of the large sums they yield every year to the public exchequer?

Lumbermen.—They cannot set fire to the forests in winter, while carrying on all the operations necessary for the cutting, squaring, and hauling of the timber; the danger only exists when they drive it down the streams in the spring and often in the summer. They light little fires wherever they stop on the banks of the rivers to dry their wet clothes and warm themselves, to enliven their few minutes of rest, or, when the season gets more advanced, to smoke away the flies. Before the fire is fairly blazing, a shout is heard and as the canoe or the crib on the loose logs darts past, our friends take a flying leap upon them, and down they go with the swift current, leaving the fire to itself.

It ought to be impressed upon the foremen, as one of their most important duties, that they must look after their men carefully in matter of fires. As the lumbermen themselves have recommended, in their conventions, careful men ought to be selected in each drive, to see that the fires are lighted and put out with every precaution; or a government woodranger might be detailed from each drive or group of drives, when close enough for that purpose; or, should that entail too much expense, each woodranger might watch over a certain length of the river. The fires are only lighted on the banks of the streams, during a drive, not inland; how easy it would be to throw the burning sticks or roll the burning logs in the water, with so many men at hand round a camp-fire.

A moment's reflection ought to convince all those who *make their living by the forest* that it is their interest to let the forest live. When the origin of a bush-fire can be traced *distinctly* to the men employed on a certain drive of timber (which might often be accomplished, with a good system of supervision), I cannot help thinking it is only fair that their employer should be made to feel his responsibility, and be deprived of his timber limits and license if he cannot make good the damage. A few examples of just severity would produce the best results.

Hunters.—Men who live by hunting, Indians and white men, do not often set fire to the forest; it is their home; neither is much to be feared from amateur hunters who conform to the game laws. All over the Dominion the season for shooting such game as is found in the forest opens generally about the beginning of September, when the driest season is over and the autumn rains begin. This is a point upon which

laws much stress is laid in the forestry regulations of Europe, and perhaps our game laws might be slightly modified to insure greater safety here.

But those who shoot in the woods out of season, ought to be doubly punished, as they ruin the game and may be the cause of ruin to the forests.

Fishermen are more dangerous than hunters. It is not their fault, and I do not mean to cast any aspersion on their character; for when we see them exercise, in the pursuit of their avocation, so much patience and coolness, we are bound to credit them with the sister qualities of caution and prudence; it is the season during which fishing is allowed (and during which only it can be allowed), the driest part of the summer, that makes it so dangerous.

In granting leases for the right of fishing rivers, it would be advisable for the government to increase the stringency of their regulations, so as to cause the lessees to be very careful how they themselves, their friends and those under them, light and put out their fires.

The precautions indicated in the Quebec act already alluded to, 34 Vict., cap. 19, especially those in section 4, for lighting and putting out of fires in the woods, are very practical and effective, and ought to be adopted and enforced everywhere. They order a careful selection of the locality, where there is the smallest quantity of vegetable matter, dead wood, branches, brush wood, dry leaves, or resinous trees; the clearing away of those inflammable materials, within a radius of four feet from the fire to be made, and the total extinguishing of the fire before quitting the place. Any honest, conscientious man, with a head on his shoulders, ought to take those precautions and be as careful of the property of others as he would be of his own. There are times, in the long droughts of summer, when a man is just as guilty who throws down a lighted match in the woods *as if he threw it in a barn full of hay.*

The enforcement of regulations made for diminishing the danger of fire, during the fishing season, would not entail such expenditure as might be expected. The wood-rangers and fishery inspectors would not have to watch over every square acre of forest; an army could not do that. An officer, well up to his work, would soon become acquainted with every good fishing pool where fisherman are likely to go, and would keep an eye on those spots; in his rounds, he might watch, warn, and arrest careless people, if necessary.

The forest rangers, fishery inspectors, and all officers connected with the protection of the forest and its contents, ought to be provided with a number of printed circulars, posters, &c., warning the people in the strongest terms, and to distribute them liberally, posting them up wherever there is a chance of their being seen; the sight of them would act as a reminder with those who could not read them.

I will not apologize for entering into all these details; we cannot achieve any great results if we overlook them.

In conclusion, fire is the only real danger to ~~be~~ dreaded for our forests: waste and pillage can be put down, however far they may have gone, *and there is a cure for them.* For fire there is no cure, nothing but PREVENTION.

(h.) Measures recommended by the Commissioner of Crown Lands for the Province of Quebec.

In 1877 the following paper was prepared by the commissioner of crown lands of the Province of Ontario, at the request of the then premier of the Province of Quebec, who had asked for information concerning the measures available for protection against forest fires and other subjects relating to the timber interests.

The subject of protection of the public forests from fires has, at different periods, occupied the attention of the Government of Canada, prior to confederation, and by this province and the Province of Quebec, since the federal union; and in prosecuting inquiries as to the best means of preventing the destruction of valuable timber by fire, parties experienced in the matter, as well as holders of timber limits who have personal interest in the preservation of the forests, have been consulted, each presenting their views from their several standpoints as to the means to be adopted, those engaged in lumbering pursuits limiting their scheme to simply preventing the ingress of settlement into lands specially valuable for pine, which as a general rule are not considered the most suitable for cultivation, the soil in hard-wood lands being looked upon as much preferable for farming purposes, but notwithstanding the several attempts made to collect information, with a view to legislation on the subject, up to confederation, no enactment was passed for the prevention of forest fires.

The projects suggested were found to be surrounded by so many obstacles to their working, so difficult to apply to the various localities, and involving such outlay in their carrying out, that on each occasion of the matter being brought prominently forward action was deferred.

In 1870 it is observed that the Province of Quebec passed "An act respecting the clearing of lands, and the protection of forests against fires." As to the working of this act this department has no information, but it may be stated that as it applies to the whole province without discriminating between old settlements and unclaimed forest lands, any such law would be utterly inapplicable to Ontario, nor is it possible to conceive how the first clause in the act referred to, which forbids "the setting fire to, or causing to burn any tree, shrub, or other plant, growing or standing in any forest or at a distance of less than one mile from any forest," could ever become operative in a country having forest lands open for location or sale.

So far no law has been passed in this province with respect to prevention of forest fires, the subject, however, has not been a dormant one; during the past year information has been sought in different quarters and opinions collected with a view to legislative enactment to secure as far as possible the forests on the public domain from destruction by fire; any law passed with this object would necessarily contain penalties either of fine or imprisonment, or both, on conviction of infraction of its provisions; but it so difficult in many cases of setting out fires in lands being cleared for settlement or in the depth of the forests, to trace their origin and bring the delinquents to justice, that, after all, the chief reliance for the suppression of the practice of carelessly or wantonly causing fires during a prohibited period of time by settlers, or by lumbermen, surveyors, trappers, and sportsmen in the dense woods, must be by persuasively impressing upon the settler the impropriety and culpability of non-compliance with the law, and certainty of punishment if detected in acting in defiance of it, bringing before licensed holders that their interest is at stake through the carelessness of their workmen, whom they should strictly instruct to take every precaution against the spread of fires in the woods at all times, but especially during river driving. As to the other parties mentioned, the severest penalties of the law should be inflicted when the origin of fires can be traced to them. As an important step in this connection, printed copies of the act should continually be distributed by wood-rangers among settlers and lumberers, and also printed notices of the same put up in conspicuous places throughout the interior for notification of other dangerous parties, renewing such notices when necessary; of course penalties would be invoked on all refractory persons, whether settler, lumberer, or others.

(i) *Remarks concerning Forest fires in New Brunswick.*

[By EDWARD JACK, of the Crown Lands Office, Fredericton, N. B.]

Those parts of the country which are most liable to the action of forest fires are such as are covered by a growth of pine, spruce, hemlock, or fir, the former tree being the most readily destroyed by them.

The nature of the soil on which birch, maple, beech, and other hard woods grow, prevents fires from doing that amount of damage which they would have done to the same quantity of land covered by soft woods. Through hard-wood land, fire generally will only run in spring, the dry fallen leaves offering the only ready fuel, since at this time the ground holds much moisture, the result of the melting of the winter's snow, which will not have entirely evaporated before the hot weather begins, and the small streams yet carry much water, all of which tends to prevent the extension of the destructive element.

After the small growth (such as the broad-leaved plants and shrubs) is fully developed, and the leaves cover the trees, fires will make but little headway in hard-wood forests.

The thick shady woods, whose trees contain but little resinous matter, keeps the soil constantly damp, and the larger plants which grow beneath them by the moisture in and around them, afford an excellent preventive to the extension of fires. The character of the soil as well as that of the rock on which it rests has much to do with the matter of forest fires.

Sandy soils are especially favorable to the support and extension of fire. Such being largely the character of that in central New Brunswick, it has consequently been more devastated than almost any other part, with perhaps the exception of some of the shires of the county of Charlotte. As the streams which flow through this central district are narrow, and generally wooded with evergreens, such as spruce, pine, or fir, no impediment is offered by them to a fire which has once got fairly under way. The soil of soft-wood lands, before it has been subjected to fire, is often covered by a coating of moss which frequently reaches around the roots of the trees. This burns almost like tinder and will retain fire for days and continue smoldering until it is extinguished by rain. Should this not make its appearance within a reasonable time, the fire creeps slowly along until it meets dry spruce tops or some other con-

¹Since this was written an act has been passed, as will be found on a subsequent page.

genial food, when it bursts out into a blaze and the result is a destructive forest fire. As respects the mineralogical character of the rocks over which the fire runs most readily, two classes among several may be selected, namely: those consisting of trape and the granitic. As these constitute extensive hill formations and mountain ranges, the quantity of soil resting on them is generally but small, while from the compact nature of their structure, as well as from their commonly steep inclination, they are the first to feel the evil consequences of drought. The friable slates of the Upper Silurian rocks, which have usually a nearly vertical dip, hold water well, and feel the effects of dry weather less than the more crystalline and compact rocks above mentioned. The truth of this statement is easily verified by comparing the fertile belt of the Upper Saint John, which rests on the Upper Silurian rocks, with the older rock formations of Saint John and Charlotte. The fertile land on the Saint John is yet covered by a magnificent forest, while much of Saint John and Charlotte have been rendered nearly worthless by fire.

(1.) THE CAUSES OF FOREST FIRES.

These are various. Sometimes, but rarely, they arise from the effects of lightning; but much oftener from the carelessness of man, and could have been prevented by the exercise of a little care and attention.

The genuine hunter, as well as the Indian, most commonly extinguishes his fire before leaving the camping-ground; lumbermen and river drivers are more careless, and if stringent laws could be enacted whereby more attention would be required to be given to this very necessary subject, a vast destruction of valuable woods might be annually prevented.

There is a law on our statute-book with respect to the burning of choppings, but there is no one to enforce its provisions, and few like to become public prosecutors.

The only instance in which I ever saw public attention called to this law was by an extract from it posted last summer in the store of C. Miller, esq., at Carleton Station, on the Intercolonial, and who informed me that he had had this printed at his own expense. As regards accidents from fires started by river drivers, it might be possible to frame a law whereby it might be enacted that on proof of a fire arising from the carelessness of the men on a drive the lumber driven by them at the time might be made liable for the payment of a certain sum by way of penalty.

Authority might be vested also in the judges of the county courts to investigate any charges of willful carelessness, and they might be authorized to summon witnesses, tax either party his costs, and impose penalties.

It is, however, from the carelessness of settlers that our most destructive fires have been started, and the only preventive to this is the entire exclusion of lands timbered wholly or for the greater part with spruce, pine, or hemlock from sale for settlement purposes; and there should be the less hesitation in doing this, since these lands in general are ill adapted to agriculture, and will produce more money to the laborer, as well as to the province, by being left in a state of nature than by denuding them of their trees. Where settlements are, however, unfortunately, actually existing on lands of this description, the present laws, and any additions which may hereafter be made to them, with respect to the setting of fires to choppings by settlers when clearing land, should be rigidly enforced, and a parish officer might be appointed in each new settlement, whose duty it should be to see that these laws be carried out and report infractions to the proper authority. There might also be furnished to each settler locating himself on a new farm a copy of any law existing or to be hereafter made with respect to burning land; and it might be provided that if any settler started a fire, carelessly or contrary to regulations, and any injury resulted therefrom to the forest on the Crown land, his grant should be withheld until he had paid such penalties as might be by law imposed, and he might also be disabled thereafter from becoming the purchaser of any other Crown lands.

(2.) RAILROADS.

Another fruitful source of fires are the railroads by which our country is intersected. As this is a matter in regard to which the Dominion Government should be consulted, it is needless to make many remarks on it.

The section-men on the roads should, however, be directed to watch narrowly any fires arising from the sparks from the engines, and report the same to the proper authority, and, since the telegraph is always near, a crew of men could be run down to the threatened locality in order to aid in extinguishing the fire. The firemen should also receive instructions as to when and where they should refrain from drawing out the ashes from their grates, and the subject of prevention of sparks escaping from the smoke-stack should also receive full attention. This subject of forest fires is one which should command much more attention than it does, since regulations respecting them, properly enforced, would save to the Province a very large sum of money annually.

(3.) PLAN PROPOSED FOR PREVENTING AND CONTROLLING.

The following plan may be further pursued for checking forest fires:

The greatest danger is from the wanton carelessness of settlers. A fire police might be appointed for all districts in the public domains, near settlements. They would need to be employed for about six months in the year only. Where the state has lumber lands in the vicinity they might at the same time be employed as preventive officers as against trespassers, and where they discovered that trespasses on the public lands were being committed by lumbermen, or had been committed during the previous winter, they should be required to give notice thereof to the proper authorities; or where public lumber requires surveying anywhere in the vicinity they might be engaged to do it. They should be furnished with copies of any laws relative to the setting of forest fires and these they should be required to distribute among the settlers. They might also take statistics of settlement and report its progress, blanks for that purpose being furnished. Without the appointment of officers for certain districts, the occurrence of forest fires cannot be checked. These districts should be just in advance of the old settlements. Where a county is well settled, and has no trees growing to any great extent, their appointment would not be necessary. They would only be needed in the vicinity of timber-lands. Each State should ascertain where its timber-lands lie, and such information might be communicated to the agricultural or forestry department.

A due proportion of timber-lands should be *entirely excluded from settlement*, which could be done with great propriety, since such lands are often worth little or nothing for farming purposes. The whole attention of the country seems directed to settlements, and none is given to the valuable timber which is too often ruthlessly destroyed. The local municipal governments in the timber districts might appoint this fire-police. A general law might be applicable to all of the different States, requiring them to protect their timber. This fire-police would need to be paid, and all fines recovered for timber illegally cut, fees for surveying, &c., might be appropriated to pay this expense. The fire-police should be continued in office during good behavior, and should not be liable to removal for political reasons.

As a preliminary measure every State should find out, and have mapped, even though it might be in a rude way, their timber districts, and the fire-police should have power to summon any number of citizens residing nearest the fire to aid in its extinguishment.

5. STATUTES OF CANADA RELATING TO THE PREVENTION AND CONTROL OF FOREST FIRES.

(a.) *Former Regulations.*

Under the former general government of Canada, authority was given to the county councils to establish by-laws for determining the periods of the year during which fires may be applied to logs, brush, and other wood, for the purpose of clearing land, and for compelling persons to adopt such measures as might be deemed requisite, to prevent such fires from extending to adjoining forests, crops, and other property.¹ It is understood that this provision is still in force.

(b.) *Province of Quebec.*

AN ACT respecting the Clearing of Lands, and the Protection of Forests against Fires.² Assented to December 24, 1870.)

Whereas it is deemed expedient to determine the periods of the year during which fires may be lighted in forests for the purpose of clearing or improving lands;

¹*Statutes of Canada*, 1855, chap. 100, sec. 12, part 5.

²This act superceded the "Act to protect forests against fires" (33 Vict., chap. 36), which differed from this chiefly in the following points: It did not include the prohibition relating to "turf, peat, stumps, fallen trees, or other timber," mentioned in the second section, nor the restrictions specified in the fifth section. The penalties were from \$2 to \$10 for a first offense and from \$10 to \$80 for each repetition, or in default of payment imprisonment not exceeding thirty days for the first offense or sixty days for each repetition.

and whereas it is further necessary to protect forests against fires: Her Majesty, by and with the advice and consent of the Legislature of Quebec, enacts as follows:

1. No person shall at any time set fire to or cause to burn any tree, shrub, or other plant growing or standing in any forest, or at a distance of less than one mile from any forest.

2. No person shall set fire to or cause to burn any pile of wood, branches, or brush-wood, or any tree, shrub, or other plant, which shall be situate or felled in the forest, or at a distance of less than a mile, or any turf, peat, stumps, fallen trees, or other timber, at any period of the year, for any cause or pretext whatsoever, except for the purpose of clearing lands, and in such latter case only between the first day of September and the first day of July.

3. Notwithstanding the preceding provisions it shall be lawful to make a fire in or near the forest to obtain warmth, and for cooking or any other necessary objects, or for all industrial purposes, such as the manufacture of tar, turpentine, charcoal, or making of ashes, for the manufacture of pot or pearl ash, provided that the obligations and the precautions imposed by the following section are observed.

4. Every person who shall, between the fifteenth of May and the fifteenth of October, make a fire in the forest, or at a distance of less than half a mile therefrom, for the purposes mentioned in the preceding section, must—

1. Select the locality in the neighborhood in which there is the smallest quantity of vegetable matter, dead wood, branches, brush-wood, dry leaves, or resinous trees.

2. Clear the place in which is about to light his fire, by removing all vegetable matter, dead trees, branches, brush-wood, and dry leaves from the soil, within a radius of twenty-five feet as regards fires made for the necessities of any industry, as mentioned in section three, and within a radius of four feet as regards fires made for the other necessary objects mentioned in said section.

3. Totally extinguish the fire before quitting the place.

5. Any person who shall throw or drop on the ground, in any place whatsoever, whether in the forests, open fields, or other place, any burning match, ashes of a pipe, cigars or part of a cigar, or any other burning substance, or who shall discharge any fire-arm, shall be bound, under the pains and penalties imposed by this act for his neglect so to do, completely to extinguish, before leaving the spot, the fire of such match, ashes of a pipe, cigars or part of a cigar, or the wadding of such fire-arm.

6. Any person contravening any of the provisions of this act shall be liable, upon conviction before any justice of the peace, to a penalty not exceeding fifty dollars, and in default of payment of the said penalty and costs of suit, with or without delay, to be imprisoned in the common gaol of the district wherein he shall be convicted for a period not exceeding three calendar months, unless the said penalty and costs of suit, together with the costs of apprehension and conveyance of the said offender to the said common gaol, be sooner paid, or to be imprisoned in the said common gaol for a period not exceeding three calendar months; or to be condemned for each such offence to the said penalty, and further to the imprisonment hereinbefore mentioned, with costs of suit in all cases.

7. Any person of full age may prosecute for any contravention of this act, and one-half of the penalty in case of conviction shall belong to the prosecutor, and the other half to the government of this province, to form part of the consolidated revenue fund of the same.

8. Every suit for contravention of this act shall be commenced within the three calendar months immediately following such contravention, and not afterwards.

9. Any justice of the peace who shall himself view any contravention of this act may impose the penalty therefor without other proof, and for the purposes of this act all agents for the sale of crown lands, all employees of departments of crown lands, all sworn land surveyors, and all wood rangers employed by the department of crown lands, all employees of the department of crown lands, all sworn land surveyors, and all wood rangers employed by the department of crown lands, shall be *ex officio* justices of the peace.

10. The act of the parliament of this province, thirty-third Victoria, chapter thirty-six, is hereby repealed.

(c.) *Province of Ontario.*

AN ACT to preserve the Forests from Destruction by Fire. (Assented to March 7, 1878.)

Whereas large quantities of valuable timber are annually destroyed by fires which are, in many instances, the result of negligence and carelessness, it is therefore necessary to provide stringent regulations for the prevention of such fires:

Therefore, Her Majesty, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:

1. The Lieutenant-Governor may, by proclamation to be made by him from time to

time, issued by and with the advice and consent of the executive council, declare any portion or part of the Province of Ontario to be a fire district.¹

2. Every proclamation under this act shall be published in the Ontario Gazette, and such portion or part of the province as is mentioned and declared to be a fire district in and by the said proclamation shall, from and after the said publication, become a fire district within the meaning and for the purposes of this act.

3. Every such portion or part of the province mentioned in such proclamation, shall cease to be a fire district upon the revocation, by the Lieutenant-Governor in council, of the proclamation by which it was created.

4. It shall not be lawful for any person to set out, or cause to be set out or started, any fire in or near the woods within any fire district between the first day of April and the first day of November in any year, except for the purpose of clearing land, cooking, obtaining warmth, or for some industrial purpose; and in cases of starting fires for any of the above purposes, the obligations and precautions imposed by the following sections shall be observed.

5. Every person who shall, between the first day of April and the first day of November, make or start a fire within such fire district for the purpose of clearing land, shall exercise and observe every reasonable care and precaution in the making and starting of such fire, and in the managing of and caring for the same after it has been made and started, in order to prevent such fire from spreading and burning up the timber and forests surrounding the place where it has been so made and started.

6. Every person who shall, between the first day of April and the first day of November, make or start within such fire district a fire in the forest or at a distance of less than half a mile therefrom, or upon any island, for cooking, obtaining warmth, or for any industrial purpose, shall—

(1.) Select a locality in the neighborhood in which there is the smallest quantity of vegetable matter, dead wood, branches, brush-wood, dry leaves, or resinous trees;

(2.) Clear the place in which he is about to light the fire by removing all vegetable matter, dead trees, branches, brush-wood, and dry leaves from the soil within a radius of ten feet from the fire;

(3.) Exercise and observe every reasonable precaution to prevent such fire from spreading, and carefully extinguish the same before quitting the place.

7. Any person who shall throw or drop any burning match, ashes of a pipe, lighted cigar, or any other burning substance, or who shall discharge any fire-arm within such fire district, shall be subject to the pains and penalties imposed by this act if he neglect completely to extinguish, before leaving the spot, the fire of such match, ashes of a pipe, cigar, wadding of the fire-arm, or other burning substance.

8. Every person in charge of any drive of timber, survey or exploring party, or of any other party requiring camp-fires for cooking or other purposes within such fire district, shall provide himself with a copy of this act, and shall call his men together and cause said act to be read in their hearing and explained to them at least once in each week during the continuance of such work or service.

9. All locomotive engines used on any railway which passes through any such fire district, or any part of it, shall, by the company using the same, be provided with and have in use all the most approved and efficient means used to prevent the escape of fire from the furnace or ash-pan of such engines, and that the smoke-stack of such locomotive engine so used shall be provided with a bonnet or screen of iron or steel wire-netting, the size of the wire used in making the netting to be not less than number nineteen of the Birmingham wire-gauge, or three sixty-fourth parts of an inch in diameter, and shall contain in each inch-square at least eleven wires each way at right angles to each other, that is, in all twenty-two wires to the inch-square.

10. It shall be the duty of every engine driver in charge of a locomotive engine passing over any such railway within the limits of any such fire district, to see that all such appliances as are above mentioned are properly used and applied so as to prevent the unnecessary escape of fire from any such engine as far as it is reasonably possible to do so.

11. Whosoever unlawfully neglects or refuses to comply with the requirements of this act in any manner whatsoever shall be liable upon a conviction before any justice of the peace to a penalty not exceeding fifty dollars over and above the costs of prosecution, and in default of payment of such fine and costs, the offender shall be imprisoned in the common gaol for a period not exceeding three calendar months; and any railway company permitting any locomotive engine to be run in violation of the provisions of the ninth section of this act shall be liable to a penalty of one hundred

¹The fire district established under this act embraces nearly all of the timber region of the province. It is bounded east by the Province of Quebec, and a line of townships running southward and westward, back of the settlements, to Lake Simcoe and Georgian Bay, and on the west by a line known in the surveys as "P. L. S. Salter's meridian line, ranges 21 and 22 west." It commences just west of the Bruce mines and runs north to the northern boundary of the province.

dollars for each offence, to be recovered with costs in any court of competent jurisdiction.

12. Every suit for any contravention of this act shall be commenced within three calendar months immediately following such contravention.

13. All fines and penalties imposed and collected under this act shall be paid one-half to the complainant or prosecutor, and the other half to Her Majesty for the public use of the Province.

14. It shall be the special duty of every Crown Land agent, woods, and forest agent, Free Grant agent, and bush ranger, to enforce the provisions and requirements of this act, and in all cases coming within the knowledge of any such agent or bush ranger to prosecute every person guilty of a breach of any of the provisions and requirements of the same.

15. Nothing in this act contained shall be held to limit or interfere with the right of any party to bring and maintain a civil action for damages occasioned by fire, and such rights shall remain and exist as though this act had not been passed.

(d.) Province of Nova Scotia.

[Revised Statutes of Nova Scotia, Fourth Series, 1873, chap. 65, p. 332.]

OF BURNING WOODS AND MARSHES.

1. The sessions shall make regulations for preventing damage by setting fire to and burning woods, underbrush, and marsh-lands, at unreasonable times, and shall affix penalties for the breach thereof, not exceeding eighty dollars.

2. Prosecutions under this chapter must be commenced within three months after the offence committed.

3. If any person convicted under this chapter shall not pay the penalty and costs, and shall have no goods whereon a levy can be made, he may be imprisoned for a term not exceeding one day for every one dollar of the amount of the judgment, unless the same be sooner paid.

4. Any person so violating the provisions of this chapter shall be liable to the person so injured for all damage resulting from such violation.

(e.) Province of New Brunswick.

[Consolidated Statutes, chap. 107, "Preventing and Investigating Fires," page 905.]

SEC. 16. Any person who shall kindle a fire in any woods or open place, and leave the same burning without being properly secured, whereby damage may be caused to the property of any other person, shall forfeit a sum not exceeding eighty dollars, and be liable to an action for the damages sustained in addition thereto.

(f.) Prince Edward Island. 1825.

AN ACT to provide a Remedy for Injuries arising from improper Burning of Woods.

Whereas the practice of setting fire to woods at improper seasons and the carelessness and improvidence with which fires are often managed, has already destroyed much valuable property, and unless restrained threaten ruin and destruction to the woods of this Island.

1. Be it therefore enacted by the Lieutenant Governor, Council, and Assembly, That any person who shall set fire to the woods at any time of the year, and thereby injure the woods or property of another, the person so causing such injury shall be liable in damages to the person so injured, and shall also be liable to the payment of a fine of five pounds for each and every such offence, to be recovered before any one of His Majesty's Justices of the Peace—one-half thereof to be paid to the person who sues for the same, and the other half to the overseer of highways within whose precinct the fire shall have been raised.

[The above act was amended in 1831 (1 W., 4 C., 6), by prescribing the manner in which the fine is to be levied, which is to be by warrant of distress on the goods and chattels of the offender, or if not found the offender is to be imprisoned for a period of not over two months. Prosecution must be commenced within six months after the commission of the offence.]

(g.) Colony of Newfoundland.

If any person shall wilfully or carelessly set on fire, or cause to be set on fire, any of the woods, forests, trees, or underbrush in this colony or its dependencies, such woods, forests, trees or underbrush being public or private property, such person shall, on being convicted thereof in a summary manner before any justice, be subject to a fine not exceeding Eighty Dollars, or be imprisoned in gaol for a period not exceeding six months; or such person may be indicted for such offence, and tried and sentenced to the like punishment by and before any court of record in this colony. Nothing herein contained shall deprive any person who may be injured by such firing and burning of his property of his right of action at law for such damages as he may sustain by reason thereof.—(*Consolidated Statutes of Newfoundland*, 1872, chap. 40, p. 228.)

(h.) British Columbia.

AN ACT to prevent the careless use of Fire in Woods and Forests.—Approved March 2, 1874.

Her Majesty, by and with the advice and consent of the Legislative Assembly of the Province of British Columbia, enacts as follows:

1. If any person, during the months of June, July, August, or September, shall ignite in the open air in any forest or woods, being the property of any other person or the property of the Crown, any inflammable material, and shall leave the same before it be thoroughly extinguished, and any damage shall result therefrom, he shall for every such offence forfeit and pay a sum of money not exceeding one hundred dollars, to be recovered in a summary way before any justice of the peace, and in default of payment thereof shall be imprisoned for any period not exceeding three months.

2. If any person shall ignite, or knowingly permit to be ignited, in the open air, upon his own land, any inflammable material, and shall, by reason of gross carelessness and negligence, permit any fire originating therefrom to escape on any adjoining or adjacent public or private property, whereby damage shall be done or timber destroyed, he shall for every such offence, forfeit and pay a sum of money not exceeding one hundred dollars, to be recovered before a Justice of the Peace in a summary way, or in default of payment thereof shall be imprisoned for any period not exceeding three months.

3. This act shall not be enforced in any district unless a petition be presented to the lieutenant governor in council signed by at least two-thirds of the settlers of such district.

4. This act may be cited for all purposes as the "Bush Fire Act."

6.—VARIOUS SUGGESTIONS, BASED UPON AMERICAN EXPERIENCE, WITH REFERENCE TO FOREST FIRES.

(a.) Plan for holding Counties responsible for Fires, as in the case of Property destroyed by a Mob.

A correspondent in Shenandoah County, Virginia, writes as follows:

I believe that forest fires could be prevented by taxing each county say \$1 per acre for each acre burnt over each year—not taxing according to damage, as that would be underrated. Fix it at \$1 per acre, and let the amount collected be paid to the State debts. Make every county surveyor measure the tracts burnt. Make it the duty of every sheriff, or deputy, or constable, to raise a force and immediately proceed to the burning woods, and press men to go along, under penalty for refusal, and let the pay be not over 40 or 50 cents for such work per 24 hours. The farmer who sets these fires to secure a little pasturage, and thereby killing all the thrifty young timber, and much of the old, would soon begin to think that this did not pay, and the poor man, who is often hired to fire the mountains, would have no interest in doing it. In fact, the sheriff would often press him into service without much pay. The county being taxed to pay \$1 per acre, the sheriff would try to extinguish the fire and let as little as possible burn, or otherwise he would never be re-elected. At present, when a fire breaks out, many will not help to extinguish it, as they wish the whole mountains to be burnt. Sometimes—yes, often, the fires are rekindled, and many laugh at those trying to extinguish the flames. I think it is time that some effective mode be adopted. Penalties and imprisonments do not amount to much. First, you can hardly find out with certainty who does it; next, if you do and would try and punish the offender, the chances are—more burnt next year. A taxation of \$1 per acre would hit some innocent persons, but this is the only way of making every man interested in keeping down the fires, and the

sheriffs and constables would have a motive for preventing the fires from spreading. Had this been a law, this county would be worth millions more than as things are at present. The whole of the mountains *must* and *will* be burnt *every few years*, and what escapes at one time will be burnt the next.

Where injury is done to private property by a mob, the law has made the county responsible to the owner for the damage done, upon the theory that an officer has been appointed or elected in each county, with ample powers to call for assistance to any extent that may be necessary to maintain the laws, and that protection is due from the government to all of its citizens. The plan above suggested has evidently been carefully studied by its author, and deserves thoughtful attention. It is evident that if it was made every man's *interest* to be careful and vigilant as to the starting of fires, on his own premises or elsewhere, and to be prompt and active in suppressing them when kindled, the damages resulting from this cause would be narrowed down to cases resulting from unavoidable accident and the rare instances of ignition from natural causes.

(b.) *Special Fire Commissioners in Towns.*

As to the best mode of controlling the spread of forest fires, a correspondent suggests the appointment of a special fire commissioner in each township, under authority of law. The person holding this appointment should provide himself with maps of his district, which could be done by the aid of county maps, and from these, which should show the location of all roads, and the extent of the woodlands and marshes, he might make himself familiar with the general character of the country, and with the roads and streams along which a defense might be made. As soon as a fire was started beyond control, he should be at once notified of the fact and of its location. Then, by observing the direction of the wind, he might arrange his plans without loss of time. He should have authority to call out and direct all the force available for the execution of his measures.

The great advantage of this would be in the saving of time in planning when every moment is precious and when prompt action is of the most urgent importance. Where the responsibility is vested in several men holding official stations in charge of other duties, there is always a difficulty in getting a meeting in time of greatest danger—generally there would be a neglect of all previous thought or plans of action, should a danger arise—sometimes a want of harmony of opinion as to the measures best to be adopted, and often a disposition to throw the responsibility upon other parties than themselves.

(c.) *Charges to the Grand Jury.*

A correspondent of the department who holds a judicial office in Virginia, in charging the grand juries of his district, is accustomed to call special attention to sections 7 and 8, chap. III, of the Criminal Code, entitled "offenses against property," which are as follows:

§ 7. If any person unlawfully or maliciously set fire to any woods, fence, grass, straw, or other thing capable of spreading fire on lands, he shall be fined not exceeding \$100, and shall be punished with stripes.

§ 8. If any person carelessly, negligently, or intentionally set any woods or marshes on fire, or set fire to any stubble, brush, straw, or inflammable substances capable of spreading fire on lands, whereby damage is done to the property of another, he shall, besides being liable to damages to the party so injured, be deemed guilty of a misdemeanor, and be fined not less than \$10 nor more than \$100.

This reference to the law to a grand jury is a practice within the discretion of judicial officers in every State and Territory in the Union

where there are laws upon the subject of forest fires, and it would be an exceedingly useful measure if these laws were modified so as to render the practice obligatory, at least in regions most liable to these calamities.

(d.) *Protection by means of Walls and earthen Barriers, Ditches, and plowed Belts.*

As a means of deliberate precaution and where materials are at hand, close stone walls afford an effectual barrier against running fires, and for this reason they might be preferred as division lines between farms and in other places where a permanent fence is required. If from their size and form the stone of which such walls are made cannot be laid sufficiently close to intercept a surface fire, the interstices may be filled with clay or adhesive soil. To render them still more effectually a barrier against running fires, no dry materials should be allowed to accumulate along their line, nor should dead and dry trees be allowed to overhang them.

A bank of earth and a ditch afford an easy line of defense, and if the latter be filled with water it will scarcely need further attention in a still time.

In noticing the blackened surface that has been burned over from sparks of locomotives or other cause, it is sometimes seen to be bounded by a single line of wagon track for a considerable distance. This suggests the advantage of plowed furrows as a safeguard against running fires, and this precaution is very generally observed upon new prairie farms in plowing several furrows around stacks and buildings. It may be made very much more effectual by plowing two sets of furrows several yards or rods apart, and carefully burning off the grass between them, selecting for this operation a time when there is no wind, and when the fire may be easily kept under control. This will generally be a few days after the first autumnal frosts.

(e.) *Extinguishment of Mountain Fires.*

As a general thing, mountain fires could be arrested before doing so much damage if all parties owning mountain lands would act promptly. As long as a fire is half a mile from a farmer's field he will rest quietly at home; and when it approaches too closely, he may, perhaps, go with a few hands and help to run it around upon the tract of another. It is suggested that a law should be enacted making all persons liable to a heavy fine who, being owners of mountain lands, should refuse to turn out and help extinguish it, although three or four miles away, with all the force he could gather. This might not be applicable everywhere, but we feel confident that it would stop all mountain fires, such as occur in thinly-settled districts. The great trouble is that those owning these lands, when they see a fire started at some distance from their lands, expect that some one else whose lands are nearer will go to extinguish it. Thus the fire is let alone, except by those whose property is in immediate danger, and their efforts are too often not equal to the task. The owners of large tracts are more inclined to act in these emergencies, and more frequently are willing to oppose the spread of fires on the lands of others. There can probably be no measure adequate for this end short of a law compelling all men to protect lands from fires where their efforts can do any good, with heavy penalties for the setting of mountain fires.

In a hilly region the spreading fires advance more slowly where there is no wind, in going down a hill than in ascending. This suggests the advantage of back-firing in the bottom of a valley, where there is often a stream to assist in checking it on one side and the counter-fire may be beyond the need of more attention before the main fire has come to meet it.

(f.) *Danger from the drifting of Light Burning Materials.*

Prairie fires will sometimes be carried many yards across belts of plowed ground or surfaces already burned over by the "tumble-weed" and the inflammable materials that it accumulates in rolling along. This plant is the *Amaranthus albus*, or "pigweed" of the gardens of the Northern and Eastern States, which grows luxuriantly upon the prairies, and when killed by frost, the lower branches contract upwards, somewhat like a ball. The plant is easily broken off or pulled up, and when thus detached it will roll great distances before a strong wind. The danger from this cause may be diminished by ditches and wire fences, but as these may become filled or encumbered, light and combustible materials should not be allowed to accumulate upon them. Hedges thus encumbered, are particularly liable to injury from fires, and we are not secure from danger from this cause until these loose materials are cleared out and burned.

The rapidity with which a prairie fire will spread depends upon the condition as to dryness and the force of the wind. In a calm they advance slowly in all directions, and men and animals may easily keep out of their way; but before a strong gale, such as sometimes prevails, and which may be increased by the fire itself, their progress is very rapid with the wind, and very slow against it.

(g.) *Fires set by Parties engaged in Driving Lumber upon Rivers.*

So far as forest fires are caused by the carelessness of men employed in driving logs on a river, it has been suggested that the foremen of parties should be held responsible for the good conduct and careful habits of the men under their charge so far as relates to the fires they may have occasion to kindle for cooking or other purposes. If impressed with the assurance that his own employment was dependent upon his fidelity in this respect, and that when discharged for negligence it would be difficult to engage elsewhere in the region where the cause of his discharge was known, it might lead to a vigilance that would tend to secure a good result. The same idea of personal responsibility and risk of losing employment might be extended to each member of the party, and proprietors might well afford to offer in advance a premium or a small increase of wages, to be paid at the end of the season, to the foremen and the men who had gone through with their work without giving occasion for complaint as to the care of fires. As a further motive for vigilance, the terms of engagement might contain a clause providing that a deduction should be made from the wages agreed upon in case of damages arising through carelessness in respect to fires, and the subject should be specially mentioned and its importance insisted upon at the time when the engagement is made.

It would also be well for operators in lumbering to cause notices to be posted in their camps, giving rules for the clearing away of inflammable rubbish before a fire is kindled in the woods, and for extinguishing it when it is left. Such notices are provided in Canada for posting

up in the lumbermen's shanties, lumber-offices, and other conspicuous places.

We have heard a measure suggested as likely to enforce caution in the care of fires among those engaged in driving logs in streams by taxing the logs of the drive to pay any damages that might result from fires kindled by the parties engaged in the operation. The sense of responsibility which this would impress was thought to be likely to secure proper vigilance as well among the owners of the timber as among those whom they employ. In cases where all the driving is managed under one direction it might be comparatively easy to establish rules and insist upon their observance, but where there are many separate parties concerned in the business the proofs in case of accident from fires might often be difficult to establish.

(h.) The agency of Trees in preventing the Spread of Fires in Cities.

The agency of shade trees in cities in preventing the easy and rapid spreading of disastrous conflagrations is worthy of notice. They serve to prevent the scattering of burning débris through the air, and they moderate the intensity of the heat, at least for a time, and until the foliage and green twigs have been dried.

Other Plans and Suggestions.

A correspondent in Maryland suggests the following management of a forest fire:

When a fire starts in a tract of woodland, have men to follow on each side of the fire-track, and rake or whip in the fire, to keep it from spreading. Don't fire against it, as that spreads it, and makes more fire. You cannot head a fire when driven by a high wind, but you can follow on each side of the track, and whip it out after the head has passed and finally thus run it to a point by stationing a picket-line along the sides to keep it from spreading laterally.

"Firing against the fire" is a mode of defense very generally practiced, and it is best done along lines of roads, or ravines. It requires the greatest caution not to start, by so doing, other fires that may prove even more destructive than the one that is being opposed. The leaves and rubbish should, if possible, be carefully raked away from the line proposed for defense, and a sufficient force should be at hand to keep the fire under control. Of course, this measure can be made available only in a still time or when the wind favors by carrying the flames towards the principal fire. In theory, a large fire in a still time causes an inward current of air from every side to supply the place of the air that is rarified and raised by the heat. This is doubtless at times noticeable in these great forest fires, and should be made available whenever it is possible. Fires are most successfully fought at night, partly because, the air being then more cool and damp, they do not in a still time burn so fiercely, and partly because they can be seen on the ground and among the leaves and moss to better advantage. The fires set by hunters may be spread from carelessly-left camp-fires, or they may be kindled to smoke out their game from its retreat in caves and hollows or for the purpose of securing a convenient view to a distance by destruction of the underbrush, or to fit the ground for a better growth of herbage, thus affording attractive pasturage for the herbivorous kinds.

There appears to be no mode of overcoming these vicious habits but a proper public opinion, and it is suggested as a matter of serious consideration that some instruction be taught in our normal schools, and from those going out from these as teachers in the public schools of the country, in reference to the great importance of the careful use of fire, and the great responsibility that may result from carelessness or accident therein.

This mode of inculcating idea of the duty of the citizen to society is well understood and often practiced in Europe, and in this we may do well to follow their example. It is only a few years since the minister of public instruction in France issued a series of circulars tending to suppress the practice of wantonly destroying the birds, because great injuries were resulting to agriculture from the multiplication of noxious insects that had followed from this destruction to excess. We have in mind at least one instance in which the responsibility with regard to fires has thus been made a subject of instruction in the schools, under the orders of a high official, and with excellent results.

In summarizing the returns from the Southern States the heedless use of fires by negroes is in some instances mentioned, in which the blame is generally attributed to their carelessness and ignorance rather than design.

A correspondent in Virginia, in alluding to this subject, says :

No article should be written on the subject of fires in the South without acknowledging the services of the colored people. They do not wait to be invited ; but wherever there is a fire there they are, doing heroic service without expectation of reward, and so far as my observation goes they can accomplish more of this kind of work than the whites.

7. FIRES IN FORMER TIMES.

(a.) *Prehistoric Fires: Indian Customs.*

Forest fires within the present area of the United States are by no means limited to the period of European colonization, for we find, besides Indian traditions, abundant evidences of exceedingly widespread and destructive fires of very ancient date. It may be generally stated that wherever there is a uniform or nearly uniform growth of timber of any species or of any size the trees that compose it have sprung up upon a burned district. On the other hand, a great diversity of species usually indicates a certain degree of antiquity, for within certain limitations of temperature, humidity, and character of the soil each species appears to be seeking to perpetuate itself wherever the opportunity offers.

It can no longer be doubted but that our "oak openings" and "barrens" of the Western States, and in many instances the prairies, are the result of forest fires, which we may fairly presume have been annually set ever since the aboriginal races in possession at the time of European settlement have dwelt in the country, and perhaps for a much longer period. In fact, a portion of the treeless soil in Wisconsin, Michigan, and elsewhere was found filled here and there with roots that scarcely showed their presence above the surface, but which opposed a serious difficulty to the first cultivation. These "grub-lands," if let alone, would in a very few years make their appearance as young woodlands without any new seeding, and wholly without any need of a theory of spontaneous generation other than by the simplest law of budding from living roots and natural growth. The mesquite and other trees of the West and Southwest afford evidence by the size and abundance of their roots that their vegetation above ground has been time and again repressed, and for a very long period, by fires, while the gain in growth in the roots has been constantly maintained under great difficulties, but with marked result, under the protection of the covering soil.

(b.) *Custom of Burning as practiced by the New England Indians.*

The Indians of New England appear to have been accustomed to the setting of fires, as appears in the following entry in the colonial records in 1677:

Whereas this court is informed that great damage hath hapned to severall persons in the outskirt plantations by Indians kindling fires in the woods in the latter part of the yeare, whereby great quantiyes of hay stackt vp in the meadowes have been consumed, for prevention whereof for time to come, and as an addition to the law, title Firing and Burning, page 51, in the last booke of lawes, wherein the time of kindling fires in woods & grounds lying in comon, &c., is limited, this Court doth order and declare, that all Indians are included in the said lawe, as well as the English; and it is further ordered by this court, that all those persons that, by this court of the Council, are impowred to inspect and governe the Indians called Friend Indians, doe forthwith publish and declare this order that to them, that they may vnderstand that not observing said law are liable to the penalty annexed.¹

¹*Records of Massachusetts, 1674-1686, p. 230.*

(c.) Reproduction of Woodlands after Fires: Views of Professor Dawson.

Professor John W. Dawson, in describing the effect of forest fires and the processes of reproduction as observed in Nova Scotia, and which are quite applicable to our forests throughout the Eastern and Northern States says:¹

It frequently happens that the woods contain large quantities of dry branches and tops of trees left by cutters of timber and fire-wood, who rarely consider any part of the tree except the trunk worthy of their attention. Even without this preparation, however, the woods may, in dry weather, be easily inflamed, for although the trunks and foliage of growing trees are not very combustible, the mossy vegetable soil, much resembling peat, burns easily and rapidly. Upon this mossy soil depends in a great measure the propagation of fires, the only exception being when the burning groves of the resinous coniferous trees is assisted by winds, causing the flame to stream through their tops more rapidly than it can pass along the ground. In such cases some of the grandest appearances ever shown by forest fires occur. The fire, spreading for a time along the ground, suddenly rushes up the tall resinous trees with a loud, crashing report, and streams far above their summits in columns and streamers of lurid flame. It frequently happens, however, that in wet or swampy ground, where the fire cannot spread around their roots, even the resinous trees refuse to burn, and thus swampy tracts are comparatively secure from fire. In addition to the causes of the progress of fires above referred to, it is probable that at a certain stage of the growth of forests, when the trees have attained to great ages and are beginning to decay, they are more readily destroyed by accidental conflagrations. In this condition the trees are often much moss-grown, and have much dead and dry wood, and it is possible that we should regard fires arising from natural or accidental causes as the ordinary and natural agents for the removal of such worn-out forests.

Where circumstances are favorable to their progress, forest fires may extend over great areas. The great fire which occurred in 1825, in the neighborhood of the Miramichi River, in New Brunswick, devastated a region 100 miles in length and 50 miles in breadth. One hundred and sixty persons and more than 800 cattle, besides innumerable wild animals, are said to have perished in this conflagration. In this case a remarkably dry summer, a light soil easily affected by droughts, and a forest composed of full-grown pine trees concurred with other causes in producing a conflagration of unusual extent.

When the fire has passed through a portion of forest, if this consists principally of hard-wood trees, they are usually merely scorched, to such a degree however, as in most cases to cause their death; some trees, such as the birches, probable from the more inflammable nature of their outer bark, being more easily killed than others. Where the woods consist of soft-wood or coniferous trees, the fire often leaves nothing but bare trunks and branches, or at most a little foliage, scorched to a rusty brown color. In either case a vast quantity of wood remains unconsumed, and soon becomes sufficiently dry to furnish food for a new conflagration, so that the same portion of the forest is liable to be repeatedly burned, until it becomes a bare and desolate "barren," with only a few and charred and wasted trunks towering above the blackened surface. This has been the fate of large districts in Nova Scotia and the neighboring colonies, and as these burned tracts could not be immediately occupied for agricultural purposes, and are diminished in value by the loss of their timber, they have been left to the unaided efforts of nature to restore their original verdure. Before proceeding to consider more particularly the mode in which this restoration is effected, and the appearances by which it is accompanied, I may quote from an article in a colonial periodical the views of Mr. Titus Smith, secretary of the board of agriculture of Nova Scotia, on this subject. These views, as the results of long and careful observation, are entitled to much respect:

"If an acre or two be cut down in the midst of a forest, and then neglected, it will soon be occupied by a growth similar to that which was cut down; but when all the timber, on tracts of great size, is killed by fires, except certain parts of swamps, a very different growth springs up; at first a great number of herbs and shrubs, which did not grow on the land when covered by living wood. The turfy coast, filled with the decaying fibers of the roots of the trees and plants of the forest, now all killed by the fire, becomes a kind of hot-bed, and seeds which have lain dormant for centuries spring up and flourish in the mellow soil. On the most barren portions the blueberry appears almost everywhere; great fields of red raspberries and fire-weed or French willow spring up along the edges of the beech and hemlock land, and abundance of red-

¹In an article entitled "*Reproduction of forests in British North America*," in Jameson's "*Edinburgh New Philosophical Journal*," 1847, vol. xlii, p. 259. Mr. D. is now principal of McGill College, Montreal.

berried elder and wild red cherry appear soon after; but in a few years the raspberries and most of the herbage disappear, and are followed by a growth of fir, white and yellow birch, and poplar. When a succession of fires has occurred, small shrubs occupy the barren, the kalmia or sheep poison being the most abundant, and in the course of ten or twelve years form so much turf that a thicket of small elder¹ begin to grow, under the shelter of which fir, spruce, hackmatack (larch), and white birch spring up. When the ground is thoroughly shaded by a thicket 20 feet high, the species which originally occupied the ground begins to prevail and suffocate the wood which sheltered it, and within sixty years the land will be generally covered with a young growth of the same kind that it produced of old."

Assuming the above statements to be a correct summary of the principal modes in which forests are reproduced, we may proceed to consider them more in detail.

1st. Where the wood is merely cut down and not burned, the same description of wood is immediately reproduced, and this may be easily accounted for. The soil contains an abundance of the seeds of these trees; there are even numerous young plants ready to take the place of those which have been destroyed, and if the trees have been cut in winter their stumps produce young shoots. Even in cases of this kind, however, a number of shrubs and herbaceous plants, not formerly growing in the place, spring up; the cause of this may be more properly noticed when describing cases of another kind. This simplest mode of the destruction of the forest may assume another aspect. If the original wood have been of kinds requiring a fertile soil, such as maple or beech, and if the wood be removed, for example, for fire-wood, it may happen that the quantity of inorganic matter thus removed from the soil may incapacitate it, at least for a long time, from producing the same description of timber. In this case some species requiring a less fertile soil may occupy the ground. For this reason forests of beech growing on light soils, when removed for fire-wood, are sometimes succeeded by spruce and fir. I have observed instances of this kind both in Nova Scotia and Prince Edward Island.

2d. When the trees are burned without the destruction of the whole of the vegetable soil the woods are reproduced by a more complicated process, which may occupy a number of years. In its first stage the burned ground bears a luxuriant crop of herbs and shrubs, which, if it be fertile and not of very great extent, may nearly cover its surface in the summer succeeding the fire. This first growth may comprise a considerable variety of species, which we may divide into three groups. The first of these consists of herbaceous plants, which have their roots so deeply buried in the soil as to escape the effects of the fire. Of this is a small species of *Trillium*, whose tubes are deeply imbedded in the black mold of the woods, and whose flowers may sometimes be seen thickly sprinkled over the black surface of woodlands very recently burned; some species of ferns, also, in this way, occasionally survive forest fires. A second group is composed of plants whose seeds are readily transported by the wind. Of this kind is the species of *Epilobium*, known in Nova Scotia as the fire-weed, or French willow (*E. angustifolium*), whose feathered seeds are admirably adapted for flying to great distances, and which often covers large tracts of burned ground so completely that its purple flowers communicate their own color to the whole surface when viewed from a distance. This plant appears to prefer the less fertile soils, and the name of fire-weed has been given to it in consequence of its occupying these when their wood has been destroyed by fire. Various species of *Senecio*, *Soldago*, and *Aster*, and other composite plants, and *Ferns*, *Lycopodia*, and *Mosses* are also among the first occupants of burned ground, and their presence may be explained in the same way as that of the *Epilobium*; their seeds and spores being easily scattered over the surface of the barren by wind.² A third group of species found abundantly on burned ground, consists of plants bearing edible fruits. The seeds of these are scattered over the barren by the birds which feed on the fruits, and, finding a rich and congenial soil, soon bear abundantly and attract more birds, bringing with them the seeds of other species. In this way it sometimes happens that a patch of burned ground, only a few acres in extent, may in a few years contain specimens of nearly all the fruit-bearing shrubs and herbs indigenous to the country. Among the most common plants which overspread the ground in this manner are the raspberry, which, in good soil, is one of the first to

¹This is not in accordance with our own observations, except in very damp places and along the margins of muddy streams, where alone the elder generally thrives.—H.

²The Canada thistle (*Cirsium arvense*) is, in some sections of the North, an extremely common weed upon half-burned and neglected fallows, its seed being carried great distances by the winds and taking root wherever they find convenient opportunity. A rank growth of this troublesome plant is generally regarded as an evidence of a rich soil, and it does not prove under proper cultivation so much of a nuisance as was formerly supposed. It will not long survive mowing when the stalks are hollow, nor will it remain long in grass meadows, although it may reappear when they are again plowed.—H.

make its appearance; two species of *vaccinium* called in Nova Scotia blueberries; the tea-berry, or wintergreen (*Gaultheria procumbens*) the pigeonberry (*Cornus canadensis*), and the wild strawberry.¹ It is not denied that some plants may be found in recently districts whose presence may not be explicable in the above modes, but no person acquainted with the facts can deny that all the plants which appear in any considerable quantity within a few years after the occurrence of a fire may readily be included in the groups which have been mentioned. By the simple means which have been described, a clothing of vegetation is speedily furnished to the burned district; the unsightliness of its appearance is thus removed, abundant supplies of food are furnished to a great variety of animals, and the fertility of the soil is preserved until a new forest has time to overspread it.

With the smaller plants which first cover a burned district, great numbers of seedling trees spring up, and these, though for a few years not very conspicuous, eventually overtop and if numerous suffocate the humbler vegetation. Many of these young trees are of the species which composed the original wood, but the majority are usually different from the former occupants of the soil. The original forest may have consisted of white or red pine; black, white, or hemlock spruce; maple, beech, black or yellow birch, or of other trees of large dimensions and capable of attaining to a great age. The "second growth" which succeeds these usually consists of poplar, white or poplar birch, wild cherry, balsam fir, scrub pine, alder, and other trees of small stature and usually of rapid growth, which in good soils prepare the way for the larger forest trees and occupy permanently only the less fertile soils. A few examples will show the contrast which thus appears between the primeval forest and that which succeeds it after a fire. Near the town of Pictou, woods, chiefly of maple and beech, in New Annan, which thirty years ago were under cultivation, are now thickly covered with poplars 30 feet in height. In Prince Edward Island fine hardwood forests have been succeeded by fir and spruce. The pine woods of Miramichi, destroyed by the great fire above referred to, have been followed by a second growth principally composed of white birch, larch, poplar, and wild cherry. When I visited this place a few years since the second growth had attained to nearly half the height of the dead trunks of the ancient pines, which were still standing in great numbers.²

As already stated, the second growth almost always includes many trees similar to those that preceded it, and when the smaller trees have attained their full height, these and other trees capable of attaining a greater magnitude overtop them and finally cause their death. The forest has then attained its last stage—that of perfect renovation. The cause of the last part of the process evidently is, that in an old forest, trees of the largest size and longest life have a tendency to prevail to the exclusion of others. For reasons which will be afterwards stated this last stage is rarely attained by the burned forests in countries beginning to be occupied by civilized man.

In accounting for the presence of the seeds necessary for the production of the second growth we may refer to the same causes which supply the seeds of the smaller plants appearing immediately after the fire. The seeds of many forest trees, especially the poplar, the birch, and the firs and spruces, are furnished with ample means for their conveyance through the air. The cottony pappus of the poplar seems especially to adapt it for this purpose. The seed of the wild cherry, another species of frequent occurrence in woods of second growth, is dispersed by birds which are fond of the fruit; the same remark applies to some other fruit-bearing species of less frequent occurrence. When the seeds that are dispersed in these ways fall in the growing woods they cannot vegetate, but when they are deposited on the comparatively bare surface of a barren they readily grow; and if the soil is suited to them the young plants increase in size with great rapidity.

It is possible, however, that the seeds of the trees of the second growth may be originally in the soil. It has been already stated that deeply-buried tubers sometimes escape the effects of fire, and in the same manner seeds imbedded in the vegetable mold, or buried in cradle-hills,³ may retain their vitality, and, being supplied by the

¹Upon light sandy soils, where pine has been cleared or burned off, we would place first on the list (as observed in Northern New York) the high blackberry (*Rubus villosa*), which form immense fields within two or three years after a fire, and attract great numbers of berry-pickers in the season, which with this fruit lasts much longer than with the common red raspberry. (*R. strigosus*).—H.

²In his *Acadian Geology*, in which this article with some changes is introduced, the author here adds the following:

"In 1866 I found that the burnt woods were replaced by a dense and luxuriant forest principally of white birch and larch, or hackmatack, and I was informed that some of these trees were already sufficiently large to be used in ship-building. This is an instructive illustration of the fact, that after a great forest fire an extensive region may in less than half a century be reclothed with different species from those by which it was originally covered."

³Inequalities of surface caused by upturned roots or the decay of fallen trunks of trees.—H.

ashes which cover the ground with alkaline solutions well fitted to promote their vegetation, may spring up before a supply of seed could be furnished from any extraneous source. It is even probable that many of the old forests may have already passed through a rotation similar to that above detailed, and that the seeds deposited by former preparatory growths may retain their vitality and be called into life by the favorable conditions existing after a fire.

If, as already suggested, forest fires in the uncultivated state of the country be a provision for removing old and decaying forests, then such changes as those above detailed must have an important use in the economy of nature, since by their means different portions of the country would succeed each other in assuming the state of "barrens," producing abundance of herbs and wild fruits suitable for the sustenance of animals which could not subsist in the old forests; and these, gradually becoming wooded, would keep up a succession of young and vigorous forests.

3d. The process of restoration may be interrupted by successive fires. These are most likely to occur soon after the first burning, but may happen at any subsequent stage. The resources of nature are not, however, easily exhausted. When fires pass through young woods, some trees always escape; and so long as any vegetable soil remains, young plants continue to spring up, though not so plentifully as at first. Repeated fires, however, greatly impoverish the soil, since the most valuable part of the ashes is readily removed by rains, and the vegetable mold is entirely consumed. In this case, if the ground is not of great natural fertility, it becomes incapable of supporting a vigorous crop of young trees. It is then permanently occupied by shrubs and herbaceous plants; at least these remain in exclusive possession of the soil for a long period. In this state the burned ground is usually considered a permanent barren; a name which does not, however, well express its character, for although it may appear bleak and desolate when viewed from a distance, it is a perfect garden of flowering and fruit-bearing plants, and of beautiful mosses and lichens. There are few persons born in the American colonies who cannot recall the memory of happy youthful days spent in gathering flowers and berries in the burnt barrens. Most of the plants already referred to as appearing soon after fires continue to grow in these more permanent barrens. In addition to these, however, a great variety of other plants gradually appears, especially the *Kalmia angustifolia*, or sheep laurel, which often becomes the predominant plant over large tracts. Cattle straying into the barrens deposit the seeds of cultivated plants, as the grasses and clovers, as well as of many exotic weeds, which often grow as luxuriantly as any of the native plants.

Lastly. When the ground is permanently occupied for agricultural purposes, the reproduction of the forest is of course entirely prevented. In this case the greater number of the smaller plants found in the barrens disappear. Some species of the Solidago and Aster, and the Canada Thistle, as well as a few smaller plants, remain in the fields and sometime become troublesome weeds. The most injurious weeds found in the cultivated ground are not, however, native plants, but foreign species, which have been introduced with the cultivated grains and grasses; the ox-eyed daisy, or white weed, and the crows-foot, or butter-cup, are two of the most abundant of these.

8. THE GREAT HISTORICAL FOREST FIRES OF NORTH AMERICA.

We have seen from the foregoing accounts that in very dry seasons, and under exceptional circumstances, fires will spread with a rapidity and advance with an energy that render all human agencies vain, and overwhelm everything before them in one fiery wave of desolation.

The possibility of occurrence of these calamities must be borne in mind, and although no suggestions can be offered for arresting them they should at least lead to greater vigilance in the use of fires during the seasons of extreme heat and drought, when they are most liable to happen, as by this means alone there is a possibility of preventing them.

(a.) *The Great Miramichi Fire of 1825.*

A fire which spread over a considerable part of New Brunswick and a part of Maine in the early part of October, 1825, may doubtless be recorded as the most disastrous casualty of the kind that had until then been known in American history.

(1.) DESCRIPTION BY DR. GESNER.

Dr. Gesner, who was thoroughly acquainted with New Brunswick, of which he had made a geographical survey, thus describes this conflagration:¹

The summer of 1825, in North America, had been unusually hot and dry, and fires had raged with more than ordinary violence in Lower Canada, the State of Maine, and Nova Scotia. In the northern part of New Brunswick, also, there had been but little rain, and almost every vegetable substance lacked its usual degree of moisture. Fires were raging in the woods at Oromocto, near Fredericton, and at other places; but from them little danger was apprehended. On the 6th of October the heat had greatly increased, and the atmosphere was clouded by smoke which rose in dense columns from different parts of the horizon. On the 7th the heat was still unabated, the heavens had a purple tint, and clouds of black smoke hovered over the devoted district. There were during the day a perfect calm and a peculiar sultriness, which is said to have thrown the inhabitants into a state of great lassitude. The cattle of the pastures became terrified and collected in groups, and the wild animals of the forest rushed out and sought refuge among the tamer breeds. These fearful signs gave little alarm to the people, who, although warned by a few individuals, confided in their distance from the forest and the tranquil state of the atmosphere. Little preparation was therefore made for the approaching calamity. At 7 o'clock p. m. a brisk gale sprang up, and the greatest darkness prevailed, except over the line of the fire, the light of which could be seen at times flashing among the clouds of smoke. At 8 the wind increased to a swift hurricane from the west, and soon afterwards a loud and most appalling roar was heard, with explosions and a crackling like that of a discharge of musketry. The air was filled with pieces of burning wood and cinders, which were driven along by the gale, igniting everything upon which they fell. The roaring grew louder, and sheets of flame seemed to pierce the sky. It was then the agonies of the distracted inhabitants appeared, and horrors of the most awful description were seen in every direction—the screams of the burnt, burning and wounded; men and women carrying their children, the sick, aged, and infirm—through clouds of smoke and showers of fires that threatened instant destruction. Many believed that the day of final judgment had arrived, and gave themselves over to despair. The piercing cry of "To the river!" was not unheeded. Some plunged into the water, others collected in boats and scows or rafts, or floated on logs, for protection. Domestic and even wild animals, uttering mournful cries, mingled with the people, the former dragging their half-burnt bodies through the cinders of their burning stalls. The whole surface of the earth was on fire, and everything of a combustible nature united in sending up the last broad flame that laid the country, with its towns, villages, and settlements, in heaps of smoldering ashes. In the space of a single hour Newcastle, Douglastown, and the villages along the northern side of the river were consumed. Of five hundred buildings only twenty-five remained. The barracks, court-house, Presbyterian church, hospital, and upwards of two hundred and forty houses and stores were destroyed at the former place. Three ships with their cargoes were burnt in the harbor, and two more upon the stocks. But the great fire had not been confined to this district. It had swept over the whole country from Bartibog to the Nashwaak, a distance of more than 100 miles. It had rushed across the mountains of the Upper Tobique, upwards of 100 miles distant, in another direction, and wrapped in flames an area of more than 6,000 square miles, and it is still painful to reflect upon the horrors experienced by many new settlers and lumbermen, who with their families perished in the burning wilderness, and whose remains were afterwards found in those attitudes of filial and paternal affection that are so fully exhibited in the hour of affliction and danger. A number of lumbermen preserved their lives by wallowing in the brooks until the fire had subsided, and a few families were preserved by similar expedients. So intense was the heat at places where the forest hung over the streams that thousands of salmon and other kinds of fish were killed and cast upon the shores. Great numbers of wild animals were also destroyed; and it is stated by an eye-witness that birds were drawn into the flames by some singular fascination.

A more melancholy scene can scarcely be imagined than this part of New Brunswick presented on the following day. The whole forest was a blackened mass of leafless and still-burning timber. Every vegetable, including the crops of the husbandman, was burnt up, and the entire surface of the land was shrouded in a black mantle. Along the northern borders of the Miramichi, groups of half-naked and houseless inhabitants were to be seen bewailing the loss of husbands, wives, children, and friends. With them were the burned and wounded, receiving the kind aid of those who had escaped unscorched. The sufferings of these people were indeed of the most painful character; but they were promptly relieved by the inhabitants of the opposite side of the river and the province generally, whose charitable associations and benevolent

¹*New Brunswick: With Notes for Emigrants* * * * By Abraham Gesner. London, 1847, p. 190.

ladies supplied money, clothes, and provisions; and, by generous contributions, the losses sustained under a painful dispensation of Divine Providence were greatly reduced.

The amount of loss incurred by the great fire, according to an account laid before Sir Howard Douglas, then lieutenant-governor of the province, and made up at Miramichi, was £227,713 13s. 6d. That sum only included personal property, goods, buildings, crops, &c., destroyed. £39,259 7s. 10d. was nobly contributed in New Brunswick, Nova Scotia, Canada, the United States, and Great Britain and applied to the immediate relief of the sufferers; but the calamity had extended almost beyond the bounds of calculation, and the province sustained an irreparable loss in her forests of timber, which has been estimated at £500,000. * * * The number of persons burnt and drowned at Miramichi was 160; buildings destroyed, 595; cattle destroyed, 875.

(2.) DESCRIPTION BY MR. MCGREGOR.

In McGregor's British America this fire is described as follows:

In October, 1825, about 140 miles in extent, and a vast breadth of the country on the north and from 60 to 70 miles on the south side of the Miramichi River, became a scene of perhaps the most dreadful conflagration that has occurred in the history of the world.

In Europe a conception can scarcely be formed of the fury and rapidity with which fires rage through the forests of America during a dry, hot season, at which period the broken underwood, decayed vegetable substances, fallen branches, bark, and withered trees are as inflammable as the absence of moisture can make them. To such irresistible food for combustion we must add the auxiliary offered by the boundless fir forests, every tree of which in its trunk, bark, branches, and leaves contains vast quantities of inflammable resin.

When one of these fires is once in motion, or at least when the flames extend over a few miles of the forest, the surrounding air becomes highly rarefied and the wind consequently increases till it blows a perfect hurricane. It appears that the woods had been, on both sides of the northwest, partially on fire for some days, but not to an alarming extent until the 7th October, when it came on to blow furiously from the westward, and the inhabitants along the river were suddenly surprised by an extraordinary roaring in the woods, resembling the crashing and detonation of loud and incessant thunder, while at the same instant the atmosphere became thickly darkened with the smoke.

They had scarcely time to ascertain the cause of this awful phenomenon before all the surrounding woods appeared in one vast blaze, the flames ascending from one to two hundred feet above the tops of the loftiest trees; and the fire rolling forward with inconceivable celerity presented the terribly sublime appearance of an impetuous foaming ocean. In less than an hour Douglastown and Newcastle were in a blaze; many of the wretched inhabitants perished in the flames. More than 100 miles of the Miramichi were laid waste, independent of the northwest branch, the Baltibog and the Nappen settlements. From one to two hundred persons perished within immediate observation, while thrice that number were miserably burned or wounded, and at least two thousand were left destitute of the means of subsistence and were thrown for a time on the humanity of the province of New Brunswick. The number of lives that were lost in the woods could not at the time be ascertained, but it was thought few were left to tell the tale.

Newcastle presented a fearful scene of ruin and devastation; only fourteen out of two hundred and fifty houses and stores remained standing.

The court-house, jail, church, and barracks, Messrs. Gilmour, Rankin & Co.'s, and Messrs. Abrams & Co.'s establishment, with two ships on the stocks, were reduced to ashes.

The loss of property is incalculable, for the fire, borne upon the wings of a hurricane, rushed upon the wretched inhabitants with such inconceivable rapidity that the preservation of their lives could be their only care.

Several ships were burned on shore, while others were saved from the flames by the exertions of their owners after being actually on fire.

At Douglastown scarcely any kind of property escaped the ravages of the fire, which swept off the surface everything coming in contact with it, leaving but time for the unfortunate inhabitants to fly to the shore; and there, by means of boats, canoes, rafts of timber, logs, or any article however ill calculated for the purpose, they endeavored to escape from the dreadful scene and reach the town of Chatham, numbers of men, women and children perishing in the attempt.

In some parts of the country all the cattle were either destroyed or suffered greatly, for the very soil was parched and burnt up, while scarcely any article of provision was rescued from the flames.

The hurricane raged with such dreadful violence that large bodies of timber on fire as well as trees from the forest, and parts of the flaming houses and stores, were car-

ried to the rivers with amazing velocity, to such an extent and affecting the water in such a manner as to occasion large quantities of salmon and other fish to resort to land, hundreds of which were scattered on the shores of the south and west branches.

Chatham was filled with three hundred miserable sufferers; every hour brought to it the wounded and burned in the most abject state of distress. Great fires raged about the same time in the forests of the River Saint John, which destroyed much property and timber, with the governor's house and about eighty private houses of Fredericton. Fires raged also at the same time in the northern part of the province as far as the Bay de Chaleur.

It is impossible to tell how many lives were lost, as how many of those who were in the woods among the lumbering parties had no friends nor connections in the country to remark on their non-appearance? Five hundred have been computed as the least number that actually perished in the flames.

The destruction of bears, foxes, tiger-cats, martins, hares, squirrels, and other wild animals was very great. These, when surprised by such fires, are said to lose their usual sense of preservation, and becoming, as it were, either giddy or fascinated, often rush into the face of inevitable destruction; even the birds, except those of very strong wing, seldom escape. Some, particularly the partridge, become stupefied; and the density of the smoke, the rapid velocity of the flames, and the violence of the winds effectually prevent the flight of others.¹

It is stated in *Murray's Account of British North America* (ii, 85) that the benevolent contributions received after this calamity were so ample that the surplus was employed in founding a school in the chief seat of the calamity.

After the destruction of the pine forests by this fire, the second growth that sprang up consisted chiefly of white birch, poplar, and wild cherry. In portions of Maine that were overrun by fire during the same year, and at or about the same time, pine and spruce timber were succeeded by white pine, with some white birch and poplar. The pine in this interval of fifty-five years has grown up into a dense forest, now of much greater value than the original forest growth.²

(b.) *The Great Peshtigo Fire of 1881.*

At the same time that the great fire at Chicago was raging (October 8, 1871), a fire was spreading through portions of the forest region and the lumbering settlements of Wisconsin and Michigan that far exceeded in extent of damage and loss of life any that had previously been known in the northwest. An account, written by C. D. Robinson, and published in the Legislative Manual of Wisconsin for 1872, gives the following account of this great calamity:

(1.) ACCOUNT AS PUBLISHED BY C. D. ROBINSON.

The great drought of the summer and fall of 1871 will long be remembered by the people of Northern Wisconsin. With the exception of slight showers of only an hour or two in duration, in the month of September, no rain fell between the 8th of July and the 9th of October—some three months. The streams and swamps and wells dried up. The fallen leaves and underbrush, which covered the ground in the forests, became so dry as to be ignitable almost as powder, and the ground itself, especially in the cases of alluvial or bottom lands, was so utterly parched as to permit of being burned to the depth of a foot or more. To use a poetical expression, which became almost a reality, "The sky was as brass, and the earth ashes."

For weeks preceeding the culmination of this state of things in the terrible conflagration of the 8th and 9th of October, fires were sweeping through the timbered country, and in some instances the prairies and openings of all that part of Wisconsin lying northward of Lake Horicon, or Winnebago marsh, which was itself on fire. Farmers, saw-mill owners, railroad men, indeed all interested in exposed property, were called

¹See also *Strickland's Twenty-seven Years in Canada West*, p. 18, *et. seq.*

²The fires in Maine in 1825 chiefly extended from near Moosehead Lake, eastward to the Penobscot River, in the southern part of Piscataquis County. It has been estimated that this burnt district was some 40 miles long by 6 wide on the average, embracing, perhaps, 150,000 acres of forest. It is the opinion of a correspondent that the birch and poplar will eventually be crowded out by the pine and spruce, leaving the forest with the same kinds of timber as before the fire.

upon for constant and exhausting labor, day and night, in contending against the advancing fires.

The saw-mills in the pine regions of Brown, Shawano, Oconto, Manitowoc, Kewaunee, and Door Counties, are, many of them, located in the very midst of the pine forests, and surrounded with a *débris* of slabs, edgings, shingle-refuse, &c., forming a ready conductor for the undermining fires in the adjacent forests to the mills and houses around them. The work of protecting these mills was long, harrassing, and exhausting, the ground being so dry that water could not be obtained from wells, and the means of defense were mainly by circumvallating the property with ditches. These were, in the main, effectual, so long as the fire preserved the ordinary character of previous forest fires, not fanned with gales nor supplemented by a long-heated and ignitable condition of the atmosphere, which, as we shall see, followed later on. In this labor of fighting fire, the mill-men, farmers, and others were engaged through October, the exhausting work going on with good cheer, in the constant hope that either the welcome rain would come, or that finally the ground would be wholly burned over and leave nothing further for the flames to feed upon. Here and there mills and houses were burned; fences, haystacks, and outlying property were swept off, but no great disaster had yet occurred. Still no rain came, and for many days previous to the great disaster a general gloom and fear seemed to have come upon the threatened region.

The long-continued labor of fighting the fire exhausted all energies and an overhanging smoke permeated the atmosphere sometimes so dense as to prevent seeing objects a few rods distant, seriously affecting the eyes and lungs. This was not alone the case in the forests, but in towns and in largely cleared settlements. In Green Bay, Depere, Appleton, Oconto, Menomonee, Kewaunee, and other places, the smoke was frequently so dense that buildings at the distance of a square were invisible. And on the lake and bay the smoke assumed the dimensions of an immense fog, obscuring the shores and rendering navigation difficult. The fires also made travel on the roads difficult and often dangerous. Trees, fallen and burning, obstructed the highways, and bridges in every direction were burned. It was a compensation in these cases, however, if it could be called one, that where bridges were gone the streams were dried up, thus allowing them to be passed without much difficulty. The Chicago and Northwestern Railway ran for 50 miles through this burning region—between Oshkosh and Green Bay—and it was only by the services of a large force of men stationed along the line that it was kept in passable condition.

The fires approached the track so closely in many places that trains had to run at increased speed to prevent their taking fire. And as an illustration of the narrow escapes on that fatal Sunday of the 8th of October we may mention that Older's circus, a long and heavy caravan, composed of upward of eighty horses and some twenty wagons, passed safely during that day over the bridges between Green Bay and Manitowoc, some of which were burning at the time, and nearly all of which were destroyed before night. If any one of the bridges which spanned the deep and impassable ravines on that road had been burned in advance of the progress of the caravan, it would have been hemmed in and destroyed. Many devices were resorted to for the protection of life. Excavations were made in the earth, with earth-covered roofs, in which persons sought refuge. Many resorted to wells which, from the long drought, had become dry. And much property which had been taken from houses and placed in the open fields for safety was destroyed, while the houses themselves frequently escaped. But time drew on, the ground was burned over, and the long-harassed people began to take breath, believing that the worst was passed.

This was the condition of things up to Sunday, the 8th of October. The air was dense with smoke and fitful blasts of hot air, so stifling that at times it was difficult to breathe. All these northern towns had kept ready, as well as they could, for the emergency. In Green Bay the fire-engines had been kept at work wetting the buildings, and an extra police force was detailed to keep watch. The buildings were so dry that a spark would set them on fire; flakes of ashes from the smoldering timbers fell in the streets like a snow-storm; and the citizens were anxious as if in the face of some impending calamity. A hot southerly gale was blowing, and in the midst of it, on Sunday afternoon, a house took fire in the central part of the city. The interior was only slightly burned, however, and the fire was extinguished before it reached the outer air. Had it obtained headway, the imagination fails to comprehend the result.

The country on three sides of the city was on fire, and on the fourth, where laid the only apparent outlet, were the waters of the bay, into which must have swarmed the population to a death only preferable to that which followed at their backs. It was the same gale which swept over Chicago. That city was then burning, though we did not know it; and that day and night the deadly blast was sweeping through the country northward, filling the land with death and destruction, unknown, as well, to us.

THE OCONTO COUNTY FIRES.

But northward from Green Bay, in Oconto County, and for some distance into Menomonee County, on the west shore of the bay, and throughout the whole length and breadth of the whole peninsula, which includes the whole of Door County, and parts of Brown, Kewaunee, and Manitowoc Counties, the fires reached their greatest devastation. The space to which we are limited in these pages will not permit of a detailed history of the whole burning, and we shall only undertake a brief description of those instances where the greatest damage and loss of life occurred. We will begin with the west shore of the bay, in Oconto County.

What is known as the Sugar Bush settlement lies between Oconto and Peshtigo, extending six or eight miles from north to south, and two or three miles in width. It was one of those cases of hard wood-timber land, which are frequently among the pine forests, and are superior farming lands. It was settled by a thrifty, industrious, and prosperous community of farmers, who owned their land and prided themselves on the beauty of their farms.

A few miles northeasterly was the village of Peshtigo. It was a village of about 1,200 inhabitants, mainly engaged in the lumbering operations of the Peshtigo Company, which had its headquarters there. The village stood on the banks of the Peshtigo River, about eight miles from its mouth, and was for that region a place of some age, saw-mills having been operated there for upwards of twenty-five years. Within the past ten years, under the energetic management of the Peshtigo Company, with William B. Ogden as one of the principal capitalists and managers, it had become one of the first manufacturing places in Northern Wisconsin. Among its features was a wooden-ware factory, recently completed at a cost of \$125,000, which was in full operation, manufacturing pails, tubs, churns, and other wooden hollow-ware. It was the most extensive one of the kind in the United States. There was also a saw-mill, a sash and door factory, a grist-mill, a machine shop, boarding-houses, an extensive store, upwards of one hundred dwelling-houses, several hotels, two churches, two school-houses, &c. A railway connected it with the "Lower Village," at the mouth of the river, some eight miles distant. It was a hive of industry, and had not probably an unemployed person within its precincts. It is estimated that on the night of the fire it had a population of 1,500 or 1,600 souls within its borders, as some 300 laborers were at work in the immediate vicinity on the new extension of the Chicago and Northwestern Railway, and a company of 50 Scandinavian emigrants had arrived there the day previous to the fire. Of these 1,500 or more people less than a thousand are accounted for since the fire, while all over the desolate plain and in the forests, and in the river-bed, human bones attest the fearful loss of life.

With the southerly gale the fire first struck the Sugar Bush. The testimony is singularly unanimous here, as well as in the cases of other places burned, as to the dreadful premouition and the final burst of flame. An unusual and strangely ominous sound, a gradual roaring and rumbling approached. It has been likened to the approach of a railroad train—to the roar of a waterfall—to the sound of a battle, with artillery, going on at a distance. The people, worn out with the long harassing fire for weeks before, quailed at this new feature, and when the flames did make their appearance—not along the ground as they had been accustomed to meet them, but consuming the tree-tops and filling the air with a whirlwind of flame—the stoutest hearts quailed before it. There have been many opinions in explanation of this apparent fire-storm in the sky. It has been attributed to electrical causes and to the formation of gas from the long-heated pine forests of that region.

We venture our own opinion, which is this: The same wind-storm and condition of the atmosphere, had they occurred on the ocean, would have produced water-spouts. There the water is drawn up by a powerful attraction from above, and the clouds descend to meet it, accompanied by a violent whirlwind. Here there were doubtless whirlwinds, having a tremendous circular velocity and moving from north to south at a more moderate speed of from six to ten miles an hour. The pine-tree tops were twisted off and set on fire, and the burning *débris* of the ground was caught up and whirled through the air in a literal column of fire. To use an anomalous expression, it was a water-spout of fire. No wonder that the stoutest hearts were appalled before such an unheard of presence, which could not be attacked nor resisted with any appliance in human grasp; and no wonder that the afflicted people abandoned every thought but that of seeking safety.

At Peshtigo hundreds were saved by throwing themselves into the river. In Sugar Bush there was no stream deep enough for such a refuge. Men, women, and children, horses, oxen, cows, dogs, swine—everything that had life was seized with pain and ran without method to escape the impending destruction. The smoke was suffocating and blinding, the roar of the tempest deafening, the atmosphere scorching, children were separated from their parents and were trampled upon by the crazed beasts; husbands and wives were calling wildly for each other and rushing in wild dismay, they knew not where. While others, believing that the day of judgment was surely

come, fell upon the ground and abandoned themselves to its terrors. Indeed this apprehension, that the last day was at hand, pervaded even the strongest and most mature minds. All the conditions of the prophecies seemed to be fulfilled. The hot atmosphere, filled with smoke, supplied the signs in the sun, and in the moon, and in the stars; the sound of the whirlwind was as the sea and the waves roaring; and everywhere there were men's hearts failing them for fear, and for looking after those things which are coming on the earth; for the powers of heaven shall be shaken. Near the town of Robinsonville, on the opposite side of the bay, in a conventual school, around which hangs a superstitious air from some circumstances connected with its establishment. It is said that the affrighted people of that vicinity thronged to it in the belief that the world was being consumed, and falling upon their faces crawled round and round it with long-continued prayers. Multitudes of other instances are related, for details of which we have no space.

The Sugar Bush was almost wholly burned away. Four dwelling houses and one or two barns were saved. The people were all either killed or driven out. Some were burned near the buildings; some were caught in the fields and woods by the descending fires; others fled to the woods and were caught there; and some found their way to Peshtigo, either to death or ultimate escape.

Of the village of Peshtigo there was not a vestige left standing except one unfinished house, which stood apart from the others and escaped. The fire burnt with such fury that but little effort was made to save any property. It had been before assailed by fire during the drought, and had been saved by great efforts; and this time its courageous people sallied forth again to renew the fight; but a few minutes sufficed to show that the enemy this time was irresistible. The men assayed a fight against it, but sent the women and children to the rear and shortly followed themselves. Most of them ran into the river, where they contested for room with the horses, cows, and swine. Some of them drowned outright, some sank after long exhaustion, and others lived the night through. Mr. W. A. Ellis, superintendent of the company's affairs there, with his family and a number of others, most fortunate, found refuge in a low or swampy place, out of the way of the worst fire. Many ran terror-stricken and without thought into places where was the least chance of safety and there perished. In the great boarding-house, inflammable in its every part, it is supposed that large numbers were burned. In the mills and factories, in out-houses, in cellars, covered by inflammable buildings; on the bridge and in the open streets they were caught by the inexorable fate and consumed. The next morning the sad remnant of the Peshtigo people, tired and maimed, found their way, on foot and in wagons, to Marinette, and to the mills at the mouth of the river. Of the warm welcome that met them, the great and generous opening of doors and hearts, and the ministering to their needs we need not dwell upon here. If there never before was such a fire there was also never before such a healing of its scars.

Northward from Peshtigo the hurricane seems to have divided into two columns or wings. The easterly one scorched the edge of the village of Marinette and swept over the village of Menekaunee, lying on the south bank of the Menomonee River, at its mouth. Here there were about fifty buildings burned, including an extensive new saw-mill owned by Spaulding, Houghtaling & Johnson, three stores, a flouring-mill, two hotels, and thirty-five dwelling-houses. Several scows, nearly a million feet of lumber, and a number of horses, cows, and other animals were burned. Clouds of burning cinders were driven across the river, and it was a marvelous escape for the village of Menomonee, immediately opposite. A mill was burned there, however—that of Kirby, Carpenter & Co.

The violence of the gale may be judged from the fact that burning cinders were showered upon the decks of vessels seven miles distant on the bay. A noble act was here performed by Captain Hawley, of the steamer Union, who loaded his boat with the fleeing people and held her ready, amid the showers of fire, to seek safety on the bay.

The western column of fire also gave Marinette a narrow escape, burning some buildings on its western border. Crossing the Menomonee it swept through the forest to the northward and struck the settlement of Birch Creek, north of Menomonee. It had a population of about one hundred, who were mainly a farming people, and had some fifteen farms. Here nineteen people were burned to death, and many were badly injured. The loss of life in the township was twenty-seven. The Birch Creek settlement extended from five to nine miles north of Menomonee.

The current of fire seemed to take a northwesterly course from here, and did not extend to the bay shore.

A surveying party of men, eight or ten persons, who were running out a line for the northern extension of the Chicago and Northwestern Railway, were in the woods near the shore, northward from Birch Creek, on the night, and slept soundly through it, not knowing the awful havoc which was going on not far from them.

We have only spoken of the towns and settlements. What occurred in the dense and lonely forests, which extend north and west for long distances, no pen shall ever tell. As

these are penetrated by loggers and hunters, charred corpses are found from time to time, and scathed trees only tell the story of the dreadful fires through which they passed.

ON THE PENINSULA.

The map will show the portion of the long peninsula which divides the waters of Green Bay from those of Lake Michigan. The county of Door is wholly, and those of Kewaunee and Brown partly, situated within its borders. The population of the interior townships is a farming one, composed mainly of Belgians and Bohemians. The country is heavily timbered with hard-wood and pine, and saw-mills are scattered along the two shores. The Belgian population began coming here fifteen or twenty years ago, and from almost utter destitution had become in comfortable circumstances, with substantial dwellings and barns and a moderate outfit of teams and cattle. This was the largest region swept by the fire; and here was the greatest loss in Northern Wisconsin. The fiery tempest may be said to have swept over its whole length and breadth, though some portions of it escaped actual devastation. The villages of Kewaunee, Ahnapee, and Sturgeon Bay were sorely pressed but were saved. So were also the lower villages of Dykesville, Little Sturgeon, and Jacksonport. These are all on the shores, and are more or less protected by open spaces around them. But the farms and clearings, hewn out of the forests and strewn with fallen timber, were ill fitted to resist the approach of the fire. The outstanding haystacks, the heavy log fences, the piles of cord-wood, hemlock-bark, fence-posts, and other products of the forests which the hard-working people get out ready to haul to the shore with the first snows, were prompt conductors to carry the fire across these cleared plains.

The most intense havoc occurred in the towns of Humboldt and Green Bay, in the county of Brown; Casco, Red River, Lincoln, and Ahnapee, in the county of Kewaunee, and Brussels, Forestville, Nasewaupsee, Clay Banks, Union, and Sturgeon Bay, in the county of Door—an area of 500 square miles. The population of these towns in 1870 was 7,857. A large part of this population suffered by the fire. Many lost everything—houses, barns, fences, wagons, hay, and grain, and in numerous instances cattle. Others lost a part of their property; and there was scarcely a family which wholly escaped that did not divide from its own scanty items with its destitute neighbors. Here and there were country stores and grist-mills. Their doors were opened, and the hungry and destitute sufferers were invited to come and take freely of whatever there was to eat and wear. It was fortunate that the weather was warm, so that there was no immediate distress from exposure; and the houseless people either huddled into the dwellings and barns, which were saved, or slept out upon their burned fields. Little enough was saved. There was no place of safety. Some attempt was made to carry out bedding and such valuables as they most prized; but the terrible gale and rain of fire sought out every hiding place. Stoves, furniture, and bedding were frequently taken to the open fields, and these were almost without exception consumed—in some cases the houses from which they had been taken escaping.

Houses were burned while adjoining barns were saved. Fences, pumps, and out-houses were burned, while dwelling houses within a few yards escaped. By mere instinct the cattle and horses mainly made their way to places of safety. Many were burned, but it is remarkable that by far the largest number saved themselves. As to the loss of human life on the peninsula there are yet no statistics. The estimates made several hundred—as high as five or six; and it will be a long time before those woods, more relentless than the waters, give up their dead.

Anticipating a little in the order of our narration, let us reply briefly to the question which the reader has doubtless already asked—how these people escaped starvation afterward? The news of the great disaster came swiftly enough to the towns and villages which had been saved along the borders of the great conflagration. It was impossible to reach the inland burned region with wagons, for the bridges were gone and the roads blockaded with fallen timber. But relief associations were promptly formed at Green Bay, Milwaukee, Sturgeon Bay, Kewaunee, Ahnapee, &c.; boat-loads of supplies were sent along the shores, discharging parts of their cargoes at every place where a landing could be made, and messengers were dispatched overland to announce to the sufferers where they could go for food. These messengers went on foot, and in what are called in this country "back-boards," a light wagon which could be lifted over obstructions. Some of the messengers were physicians, who carried stocks of medicines and liniments, and who did the double duty of ministering to the sick and burned, and announcing to all where they could find supplies. Flour in bags of a convenient size to be carried on men's backs, bacon and salt meats, and cooked provisions of all kinds constituted this relief in the first days after the fire. And in proof of the energy with which the service was performed it should be stated that, before the week was past, there was probably not a hungry person in all that stricken and almost impenetrable region.

At Williamsonville, some few miles from the Bay shore, in Door County, the brothers

Williamson had lately started a saw-mill, mainly for the manufacture of shingles. There were three brothers, who had taken with them to their new home their mother, father, sisters, wives, and children. They had built their mill, dwelling-houses, barns, and shops, and had been at work for some months, sending their shingles by teams to the Bay shore for shipment. This little settlement, which contained on that fatal day perhaps sixty or seventy persons, had been threatened by the underrunning fires on the ground for weeks, and had made a long and exhausting defense against them. But at last safety seemed assured. Everything combustible on the ground had burned out. Though the country was still smouldering and the air dense with smoke, the little colony believed the worst to be over, and that Sunday morning seemed so full of peace and promise that most of the tired people gave themselves up to rest, while others went off to spend the day with their friends in adjacent settlements. When these got back to their work on Monday morning there was no vestige of the place. There was no mill, nor building, nor living thing.

Mrs. Williamson, the mother and grandmother, a lady of upwards of sixty years of age, and one of the only two of that family saved, tells the story most intelligently. Towards evening a dull ominous roaring came from the northward. It was unlike the wind, for there was a hot and sickening blast coming before it. A dismal glare fell upon the gloom of smoke overhead. There was no fire visible when this ominous warning called the people to their doors, and they stood for a time, a fear creeping over them as of the coming of some unknown calamity. What wonder that they imagined themselves in the presence of the last dread day, when the flames came through the air, above the tops of the trees, and descended upon them?

There was no attempt at saving property. The fire-beleaguered people, who for weeks past had in mind penciled plans of safety in case of defeat in their hazardous fight, ran in terror to those places. A shallow pit, in which potatoes had been buried, seemed to be the favorite refuge. Into this hole, not six feet in diameter, a large number threw themselves, overcrowding it, and trampling upon and probably suffocating each other. It is said that nearly fifty undertook to hide themselves there. Others threw themselves into wells, and into the bed of a little rivulet which trickled through the place, and perished there; while some few fortunately sought the adjacent timber, where the ground had been previously burned over, and were saved. Next morning the absent workmen arrived, and the work of burial began. Fifty-nine bodies were found. Only a few escaped. Some one in the early part of the fire, had led Mrs. Williamson, the grandmother, to a large stone, with its surface just above the ground, and placed her on it, with a coverlet over her head to protect her from the falling cinders. Here she spent the night safe, as if by miracle. Her hands were badly burned in scraping away the fire which fell around her and in extinguishing the sparks which fell upon her dress, and she came near being set on fire by the burning corpse of a woman who had fallen beside her. "I cannot pretend to understand," she said to us some days afterwards, "the providence of God which preserved me, an old woman, with my days fulfilled, and took my sons and daughters."

In Rosiere, in Door County, there were forty-four dead bodies found next day. Those who lived to describe the conflagration there find no term but that of lightning with which to compare the flames. The fire was transformed into an electric current of fervid heat, and the heavens seemed to be rolled, as it were, in a scroll. Men, women, and children were suffocated and found fallen on the ground with no marks of fire upon their persons. In Forestville thirty-five of the inhabitants were found and buried the day after the fire, and others have been found since. Most of the bodies were found lying with their faces to the ground, and generally not much burned. They died from suffocation. In Brussels twenty-two were found dead. In Union, Nasewaupee, and other towns considerable numbers have been found and buried, and others are still missing.

A writer in the *London Spectator*, referring to the peculiar character of these fires, suggests that they may have been caused by a condition of the atmosphere similar to the well-known Föhn wind of Switzerland, and quotes the following passage from an eminent naturalist respecting this wind: "It is the terror of the country. Fires are immediately extinguished on every hearth and in every oven, and in many valleys watchmen go about to make sure that this precaution is observed, as a single careless spark might cause a disastrous conflagration in the dried up state of the atmosphere."

(2.) ACCOUNT AS GIVEN BY THE ABBÉ PERNIN.

The Abbé Pernin, a Catholic missionary, then living at Marionette, had also under his charge a newly-established church at Peshtigo, where he happened to be at the time of the fire. He has published a small book upon the subject, which affords much information concerning the event,

of which he was a spectator.¹ The graphic description of the country which he gives at the beginning of his little work will better enable the reader to understand the situation :

Picture to yourself a country covered by a dense forest growth, in the midst of which, here and there along the roads, a clearing of greater or less extent—sometimes half a league wide, to make room for a young city, and at other times three or four acres, the beginning of a farm. Except in these little spots where the trees had been cut and burned, the whole country was a rude but majestic wilderness—woods, everywhere woods, and nothing else as far as one might wish to go, from the bay towards the north and west. The surface was generally uneven ; in the valleys grew the cedar and the spruce, and on the sandy hills evergreens, and on the places where the land was dry and rich were all kinds of hard wood, the oak, maple, beech, ash, elm, and birch. The temperature of this region is generally quite regular, and propitious for grains that have begun to be sown and that generally do well. The rains are frequent and seldom fail in seasonable time. But the year 1871 had been exceptionally dry, and the farmers, availing themselves of this opportunity for enlarging their fields, had made large cuttings for burning off. Some hundreds of workmen were also at that time employed in opening a railroad, and they used the ax and fire freely in advancing their work. The hunters and the Indians roam continually through these forests, especially in autumn, at which season they follow up the streams to fish for trout, or scatter through the woods in hunting deer. When the evening comes they kindle a great fire wherever they happen to be, cook their suppers, spread down their blankets, and, rolling themselves up, they sleep in peace, well knowing that the fire will keep off the wild animals that might be passing in the night. In the morning they depart, leaving behind them the embers that have protected and warmed them, without a thought about extinguishing them. The farmers do the same thing themselves, so that in autumn these woods are everywhere filled with fires that have been kindled by the hand of man, and, finding an abundance of dead leaves and dry branches, the flames spread to greater or less extent. When the wind rises these fires sometimes take fearful proportions and sweep everything before them.

The village of Peshtigo, a place, he says, of some 2,000 inhabitants, had on the 24th of September, about two weeks before the great fire, been saved with difficulty from a great disaster, as thus described in a Green Bay paper soon after :

It was a grand spectacle to observe this fire in the night. It shot up to the summit of the largest trees, the flames coiling around them like immense serpents, and, leaping from branch to branch, they illuminated the whole country. Darting tongues of fire into the midst of the green foliage, they created a moaning and roaring through the forests as in a fearful tempest.

Every few moments some ancient firs along their enormous trunks suddenly became so many columns of flames, crackling for a time and then falling with the noise of thunder, raising great clouds of sparks and new and dense volumes of resinous smoke. The somber contrast of these volumes of black smoke above seemed to announce the speedy death and desolation of everything below.

Thousands of birds, aroused from their perches, flew about, not knowing what direction to take, uttering cries that made the night still more hideous as they called to their mates, turned a few times in the air, and then disappeared in the furnace of flames below them. Thus the night passed, all hearts praying for rain ; but it came not.

On Sunday morning the wind fell into a calm, the fires seemed to be dying out, and we began to hope that the danger was past. But about 11 o'clock, while many people were in church, a gust of wind made the edifice creak, and the whole congregation rushed out to see what was about to happen. The fire had got a new start in a log-cutting in the woods, and the wind was blowing strong from the northwest. The forest fires were raging worse than ever, and were approaching directly towards them. The air was literally filled with cinders and sparks of fire ; the engine was brought out, and hundreds of pails were got from the factory, and everything possible was done to prevent the fire from getting into the village. But suddenly there appeared a new danger, for the wind changed to the west, where the fires were rapidly advancing, and it seemed that nothing short of a miracle could save the whole from destruction, and clouds of smoke filled the air so densely that no one could see what to do or where the

¹*Le doigt de Dieu est là ! ou épisode émouvant d'un évènement étrange raconte par un témoin oculaire*, 18mo. Montréal, 1874, pp. 101. An English edition was published at Montreal the same year. It did not come to our notice until after our article had been prepared.

danger was greatest. The most energetic measures were, however, adopted for arresting the progress of the fires, by hauling water upon wagons, and by an organized plan of fighting the fires, all hands being employed that could be brought to the work. Some packed up their valuables and hastened away, deeming a great conflagration as inevitable.

I have seen the prairie fires run with the speed of a locomotive. They are grand and terrible, but insignificant in comparison with a fire in the forest. In proportion as the woods are more dense and high and large than the prairie grass, by so much the more are the forest fires more intense and grand. The fires on the prairies, when driven by the winds, glide over the dry and dead herbage, but they soon leave no trace of fire behind, except the blackened surface; but in the woods they not only travel quite as fast, but they hold longer, and produce a heat that is infinitely more intense. It is no easy matter to withstand a sweeping forest fire, for if you try to stay its progress you run an imminent risk of being surrounded by the flames.

These premonitions had led many to take every precaution, such as digging trenches, providing barrels of water, and removing combustible materials; all of which were precautions very well at common times, but in this case amounting to nothing whatever.

The Abbé Pernin, in describing the conditions of the atmosphere on the fatal day (October 8), says:

My afternoon passed, I scarcely know how, sometimes in complete inactivity. My mind was a prey to some vague disquietude as to some dreadful event, which I cannot describe, while, on the contrary, reason seemed to say to me that I had no more to fear than for the last week or two past, nor so much, because many precautions had been taken, and a great many persons were taking care of the public safety. Sometimes one of these opposite sentiments would prevail, and then the other, but the one that came against my will prevailed over the reasoning, and threw me into a kind of mental torpor that paralyzed all my energies.

Out of doors everything seemed to favor these opposite impressions. The dense smoke that obscured the sky, a stifling and heavy atmosphere, a mysterious silence in the air—the common presage of a tempest—made me fear in case of a sudden springing up of the wind, while, on the contrary, the streets were full of people passing to and fro, having no idea but to amuse themselves with songs and laughter, and their total indifference as to the atmospheric conditions made me at times think I had been deceived, and I was ashamed to evince any signs of the terror that pursued me.

* * * At about 7 o'clock in the evening, being still oppressed with this indefinite foreboding, I went out to learn what were the impressions of neighbors.
* * * We went out together into the fields, and noticed that the wind would at one moment try, as it were, its whole force, and then suddenly rest. Presently, as we were together in the field, the wind arose more strongly than before, and I saw some old stumps of trees take fire here and there without a spark of fire touching them, as if the wind itself had set them on fire by its mere contact. We extinguished these fires, and the wind then subsiding, nature relapsed into a mournful and mysterious silence, as before. We returned to the house and sat down, but I soon arose: I had no energy, and yet I could not rest anywhere. Returning to my house, I raised my eyes towards the west, from whence the wind came every time that it blowed, and I noticed above the thick bed of smoke that covered the earth, as it were, by reflection from the sky, an immense glowing red light, and then in the midst of the silence that reigned around me there came a heavy sound, roaring in the distance, announcing that the elements were at strife.

A sudden impulse then prompted him to provide for saving his most valuable effects, which he did by burying them in the sand¹. The air was enervating and his strength almost failed him, and it became more and more certain every moment that a great calamity was close upon them. The glowing red of the western sky grew brighter as he viewed it, and he heard the roaring of the flames coming nearer and nearer, and in the midst of the otherwise calm moments a dull, rumbling, and terrible sound was heard steadily approaching, and seemed to gain strength every instant as it came nearer, like the echoing roar of many thunders, or the confused noise of many carriages, or the approach of a railroad

¹ These, although covered a foot deep with sand, were mostly destroyed by the fire, or by an electric current that had consumed the substance but left the form, which, however, crumbled at the first touch.

train, but with this difference, that it seemed to be in the space above, and did not cease an instant as it increased and approached.

In minutely describing these incidents of this fire he mentions one circumstance that strongly indicates a remarkable electrical condition in the atmosphere at that time. He had occasion to go into a room in the dark, to remove some article :

It was then that I observed a phenomenon that struck me as remarkable, in a flashing that shone suddenly like grains of powder touched by fire, and that flew from room to room. It seemed as if the atmosphere were saturated with some gas ; and if this gas, thought I, takes fire when nothing comes in contact with it but a breath of warm air, what will it do when the advancing flames shall strike these inflammable objects ? The phenomenon was indeed threatening, but I had nothing to fear ; I felt that I was ready to depart, and it seemed to me that I would be saved.

In speaking of the scene and events at the river, he says :

The vortices of wind, in their constant rise, had, so to speak, pumped up the smoke, the dust, and the ashes, so that we could see clearly. The river bank, as far as the eye could reach, was crowded with people, upright and motionless, along the edge of the water. Some had their eyes open and raised to heaven, but the most of them had no idea that they could do anything to save themselves, and some believed, as they afterwards said, that the end of the world had come. * * * Being out of breath, I could not speak, but pushed into the river those who were nearest, and plunged in myself. An instant after, I heard a splashing all along in the water, and it was none too late, for one could scarcely breathe ; the intensity of the heat increased, and in a few moments nothing could withstand it. * * * Once in the water up to the ears, I thought myself safe from the fire, but this was not so. The flames ran upon the water as upon the ground ; the air was filled with them, or rather the air was fire. It seized our heads, and we were obliged to throw water continually with our hands upon our hair and the parts necessarily exposed for breathing. Many persons had thrown clothing and bedding into the river to save it, and whenever any of this came within reach, it was seized and used as a covering ; but it dried so quickly by the heat that unless wet continually it would take fire.

The horrid whirlwind that had blown so fiercely as I left my yard had, as I have remarked, clarified the atmosphere ; the river was bright—brighter than day—and looking up and down, I saw everywhere heads just above the level of the water, some bare and others covered, but all continually throwing water with their hands or striking their hands upon their heads. Turning my looks from the river, I saw on the right hand and on the left that the firmament showed nothing but fire. Everything was on fire—the houses, the trees, and the atmosphere itself. Above my head, as far as my vision could penetrate space, alas ! too clearly, I could see nothing but flames, immense billows of flame that covered the whole sky, and rolled one upon another, as if violently agitated, as we see clouds driven in a storm—a sea of waves and a horrible tempest of fire.

Such as survived this terrible scene were unable to come out of the water until five hours and a half after they had entered, when such as were able crawled out, chilled through and almost wholly exhausted by the cold of the river, and very many of them cruelly burned and almost dead from the fire.

In a subsequent page the writer, recurring to the atmospheric conditions just preceding the fire, says :

It is hard to doubt but that the atmosphere was at that time saturated with an inflammable gas destructive to human life. I have mentioned the flashes of light leaping in my rooms just before I left the house. On going to the river, I met in some places strata of air in which I could scarcely breathe, and where I had to stoop almost to the ground to catch breath, although the violence of the wind would almost throw me down in spite of my efforts to prevent it. While I was in the river, and on looking up, I could see, as already mentioned, as it were, a sea of fire violently agitated by the wind, and immense waves of flame, rolling one upon another, mounting to a prodigious height in the air, and of course far above the reach of all inflammable materials. How can this phenomenon be explained without admitting that there were great bodies of some such gas collected in the air ?

It was passing strange, but some dead bodies showed no marks of burning, and although their pockets were untouched, their watches and copper coins or other metallic objects were melted. How, again, did it happen that here and there some human lives were spared on farms and in the woods ? This is a difficult question to

answer, excepting that the tempest did not rage everywhere alike? To the survivors it was mere chance, for no one could boast of more presence of mind than another. Such persons generally happened to be in some hollow place, or some excavation, or on freshly-plowed earth, with which they could cover themselves, and the tempest of flame swept over at a little way above the surface, for no one could have stood upright without being struck instantly with death.

There was something stranger still. Some persons, at the moment when the whirlwind came, being suddenly surprised, ran out of doors, as if to take a view of the elements, and several of them agree in relating this marvelous thing: They say that a great black object, like a balloon, whirling with intense rapidity in the air, along the tops of the trees, approached with threatening aspect toward the house which it seemed to select. It had scarcely touched it when it burst with a loud explosion, like a bomb filled with powder, and at that instant streams of fire scattered off in all directions, and, as if in a flash of lightning, the house was wrapped in flames, and so suddenly that those within had not a moment's time to escape.

(c.) *Forest Fires in Michigan in the Autumn of 1871.*

Having thus noticed the ravage of these fires in Wisconsin, we will next give some account of what had happened at the same time in the Lower Peninsula of Michigan. During the intensely dry season that had preceded, forest fires had been working in the swamps and woodlands, and isolated cases of the burning of buildings, fields, and crops, both standing and harvested, had been common. These fires, fanned by a strong wind, began to spread with fearful energy about the 8th and 9th of October, both along the Lake Huron shore and along the eastern border of Lake Michigan, and suddenly the country was startled with the intelligence that the whole of Huron County and large parts of Sanilac, Tucola, and Saginaw, on the eastern side, had been overrun by fire, and that the villages of Sand Beach, Port Hope, Forestville, White Rock, Elm Creek, Huron City, Forest Bay, Center Harbor, and Verona Mills were almost wholly destroyed. On the west side, Manistee, Holland,¹ and the little port of Glen Haven were mostly burned, and as fuller accounts were brought in it became known that these fires, spreading far into the interior, not always continuously, but everywhere with most destructive energy, had destroyed a multitude of hamlets, mills, dwellings, buildings, and bridges, which were never counted up, and had consumed farm-fences, fields, and forests to an extent that could never be estimated.

Some idea of the extent of this disaster may be learned from the following proclamation of Governor Baldwin, of Michigan, a few days afterwards:

STATE OF MICHIGAN, EXECUTIVE OFFICE,
Detroit, October 16, 1871.

To the People of Michigan :

While we have been occupied in the noble work of furnishing relief to the sorely afflicted people of the neighboring city of Chicago large sections of our own State were being devastated by the same terrible scourge of fire.

Several counties have been almost entirely ruined, thriving cities, towns, and villages have been reduced to ashes, mills giving employment and support to hundreds of families, whole townships of valuable timber, dwellings, barns, crops, and property of every description have been totally destroyed. The destruction of both life and property has been appalling; thousands of our citizens have been rendered homeless, and are destitute of the absolute necessities of life.

The calamity which has befallen our people, terrible as it would be at any other time, is doubly so at the commencement of the approaching inclement season of the year, and calls most earnestly upon every citizen of the State who has escaped this sad disaster to contribute promptly and liberally towards the relief of these our suffering fellow-citizens. While contributions for the afflicted people of Michigan have

¹At Holland only sixty buildings were saved, including Hope College, two churches, a school-house, and a mill. In less than two hours fifty-five stores, four churches, three newspaper offices, and a great number of dwellings were destroyed.

been, and probably will continue to be, made from other States, such cannot be depended upon. Reliance must be placed mainly upon the people of our own commonwealth. I therefore appeal to the people of Michigan to meet this emergency with a degree of promptness and liberality measured only by the urgent necessity of the case.

In order that contributions may be distributed judiciously and wisely, it has been deemed best to appoint two State relief committees; one of these located in the city of Detroit and composed of the following persons: *M. Garrison*, chairman; *Charles Kellogg*, treasurer; *Wm. G. Thompson*, and *Geo. McMillan*.

The other, in the city of Grand Rapids, composed of the following-named persons: *Hon. Thomas D. Gilbete*, *Hon. Wm. A. Howard*, *Hon. Henry Fralich*, and *Capt. Robert Collins*.

It is requested that money, clothing, food, or bedding be forwarded to one or other of these committees, as may be most convenient to the donors. The State committees will appoint one or more persons in the several counties to whom contributions from the townships may be sent, and by whom they will be transmitted to one of the State committees. Let us remember "that it is more blessed to give than to receive."

HENRY P. BALDWIN.

The State committee, in their appeal, state that from 12,000 to 15,000 people had lost their homes, food, clothing, crops, horses, and cattle. These calls for benevolence were so promptly responded to that on the 9th of January, 1872, Governor Baldwin announced that no more money was needed for Michigan sufferers; and in concurrent resolutions of the Michigan legislature, dated March 28, it was stated that three-fourths of a million of dollars had been donated by the people of that and other States, and applied with a fidelity that commanded admiration. Relief committees and railroads and express companies were thanked, as also the donors, whose lavish contributions had alleviated the wants of eighteen thousand homeless and destitute people.

In a message to the legislature, dated March 12, 1872, the governor reported the receipt of \$462,106.30 by various committees, besides large quantities of clothing and other supplies, valued at \$250,000, and from the Federal government, through Lieutenant-General Sheridan, large quantities of blankets, clothing, and other supplies. A tender of clothing was made by the Hon. George M. Robeson, Secretary of the Navy, which was declined as not needed. A large number of bridges having been destroyed, the State board of control took prompt measures for rebuilding them, and made appropriations of swamp lands for that purpose.

As for the origin of these fires, they spring up at many points, and doubtless from various causes, the principal one being the clearing of land. They acquired energy from the extreme dryness of the soil and of everything combustible, aided by hot and dry winds, and by an exceptionally strong tendency for the spread of flames in the atmosphere itself, perhaps due to electrical conditions or other causes.

Fires had been burning in Huron County and elsewhere for three months before the final conflagration, and these previous fires appear to have contributed to bring about the conditions above described, and which, from the accounts that appeared in the journals of the day, must have been quite extraordinary. The *Detroit Tribune* of October 11, 1871, says:

From every direction come tidings that the surrounding fires for the past few weeks have been lashed into fury by the recent prevailing high winds, and the marshes and woods are ablaze on every side, the dry and parched earth itself furnishing a free conductor for the harrowing and burning element that ran underneath, and thus spread as well upon the surface far and wide. Farm buildings, fences, and stacks of hay and grain have fallen a prey, and the damage that has been inflicted upon woodlands and productive fields is wellnigh incalculable.

Tuesday afternoon (October 10), our citizens were startled by the news that the country all along the shore of Lake Huron, from Lexington northward, was on fire, the same extending miles back into the interior, and that Forestville, White Rock, and other towns had all been destroyed. * *

At Forestville the fire broke out about 1 a. m. on Monday morning (October 9), and all the inhabitants were compelled to rise and flee for their lives. The whole village was burned, not a house being saved. * * * The village of White Rock, about six miles north, is almost entirely destroyed. * * * Not only has the fire burned buildings, forests, &c., but the ground itself is so dry that the soil has been destroyed, the fire reaching frequently 12 or 14 inches below the surface.

For safety the inhabitants in some cases were driven into the lake, being obliged to cover themselves with water, excepting their heads, to keep from the heat, while others, young children, were held in the arms of strong men, at a sufficient distance from the shore to keep themselves from the fire. Thus they were kept for hours, watching while all was being consumed, and waiting for the fire to subside before they could come ashore. The loss at White Rock is estimated at \$250,000, and at Forestville it will reach \$400,000.

The same journal, the next day, in continuing the record of losses says:

The villages of Elm Creek, Centre Harbor, Sand Beach, Huron City, and New River, all in Huron County, have been completely destroyed by fire. The docks are all burned at Elm Creek and Huron City. The bridges are all burned from Rock Falls to Richmondville. * * * Nothing is left of good farms but the bare land, the inhabitants in many cases scarcely escaping with their lives, and then they were compelled to run to the lake and stand in water up to their necks, and in this position to remain for hours. Even then their heads were in danger of burning while in this terrible situation. Some escaped the fire by jumping into wells, and even then were compelled to fight to keep from burning.

Other accounts record the wind blowing a fearful hurricane, the fire being heard at a distance like the roar of the sea, and balls of fire falling like meteors from the burning tree-tops and igniting all that they touched. The flame, as it arose, drew in the surrounding atmosphere, already parched and heated in extreme degree, until it became a tornado of fire, sweeping everything before it.¹

At about the same time that these fires, so destructive to property and to human life, were raging in Michigan and Wisconsin reports were coming in of extensive ravages by fire in the Cumberland Mountains and other distant parts of the country, showing that the great drought of that year extended far and wide, and that like causes were elsewhere producing like effects. Taken in connection with the great calamity at Chicago, the autumn of 1871 may be regarded as altogether the most extraordinary in the annals of disaster from fire that has ever happened within the period of human history.

9.—LIABILITY OF SCORCHED PINE TIMBER TO THE ATTACK OF INSECTS.

Forest fires, especially in coniferous woods, cause another injury, much beyond the actual destruction of timber by burning, in this, that the trees that have been killed, or even scorched by the fire, become liable to attack by wood-boring insects. The larvæ of these, by boring large galleries in the substance of the wood, will in a single season render it worthless for sawing or use in any form than as firewood, and quite inferior for that. These insects belong to several families of the *Coleoptera*.

(a.) *Paper by Prof. E. Billings on the Injuries of the Monohammus.*

In a paper read before the Natural History Society of Montreal by Mr. Elkanah Billings, then palæontologist to the Canadian geological survey, an account is given of the habits of the pine-boring beetles of the genus *Monohammus*, that have an interest in this connection:²

It appears that in Canada we have four species of beetles belonging to the longicorn genus *Monohammus*. The largest and apparently the most abundant of these is

¹For Report of the Fire Relief Fund in Michigan see *Governor's message*. Ex. Docs. 1872, vol. I, p. 23.

²*Canadian Naturalist and Geologist*, 1862, VII, p. 431.

the *Monohammus confusor*, a magnificent insect, and very destructive to the several kinds of pine timber of this country. The length, exclusive of the antennæ, varies from three-fourths of an inch to one inch and a half, the majority of individuals being about thirteen lines. The antennæ of the males vary in length from one and a half to three inches; the female is about the same length as the male, but her antennæ are always shorter and her body broader. When very perfect, these insects are of a light ash-gray color, with a few dark-brown spots. The gray color is due to a coat of very fine short light hairs. When these are rubbed off the head and thorax are seen to be nearly black and smooth and shining, the thorax being scarcely at all punctured. The elytra, when deprived of the hairs, becomes of a horn color, darkest near the thorax, and covered with small punctures. Some specimens are almost entirely destitute of the dark brown spots, and in general the number and size of the marks vary a good deal. On each side of the thorax there is a short broad-based spine. The antennæ consist of eleven joints, the second of which is very short, and the first much thicker than any of the others. This species is found in all parts of Canada where there are pine trees, and Dr. Leconte says it is abundant at Saratoga in New York.¹ A specimen has been caught flying in the streets of Philadelphia.² Next in order is *Monohammus scutellatus* (Say.), which is about one-fourth smaller than *M. confusor*, and can always be readily recognized by its dark, nearly black, shining bronze color, some of the individuals having a few irregular spots of yellowish white scattered over the surface. The thorax and elytra are rugose, with large transverse punctures, or rather short confluent wrinkles, distinctly visible to the naked eye. The scutellans is white, the thorax armed with a short spine on each side. The length of this species is usually eight or ten lines, but individuals of from five to eight lines are occasionally met with. The antennæ are from three-fourths of an inch to two inches in length.

This species, although not so abundant as *M. confusor*, appears to have a more extensive geographical range. It occurs in all parts of Canada, and it is found also in Nova Scotia, and in the Hudson Bay territories northward to the Arctic regions. Mr. Couper says it was taken by Sir John Richardson, at Fort Simpson, on the Mackenzie River, in latitude 62° north.³ Mr. D'Urban says it was procured by Mr. Barnston from Great Slave Lake, in latitude 54° north.⁴

The third species is *Monohammus marmoratus* (Randall). It is described by Le Conte as being very much like *M. confusor*, the principal difference consisting in the markings of the thorax, which is closely covered with large rugose punctures, while in *M. confusor* this part is not punctured. The antennæ are black, and in the female annulated with gray. The elytra are quite scabrous at the base from elevated points; Le Conte now united with it *M. maculosa* (Haldimond) and his own two species, *M. mutator* and *M. fatuor* the first of the latter two described in Agassiz's Lake Superior, and the last in the Jour. Acad. Nat. Sci., Phil., [2.], ii., 148. It is abundant at Lake Superior. I have never seen it; and if it occurs in the valley of the Ottawa it must be very rare. The fourth species is *Monohammus titillator* (Fabricius). Mr. Couper cites it as occurring at Toronto.⁵ It is also given in Mr. Ibbetson's list of Canadian Coleoptera.⁶ As neither of these two entomologists mention *M. confusor*, and as the original specimen on which the species *M. titillator* was founded is an insect from the Southern States, it may be that they have applied the name to our most common and largest species. This question, however, remains to be decided by further observations. * * * The first two of these species, *M. confusor* and *M. scutellatus*, attack and destroy great quantities of pine timber. No doubt the other two species do also prey upon the pines, but I have never yet observed them, and in fact they appear to be either rare or of a limited geographical distribution. The trees attacked by them are the white or Weymouth pine (*Pinus strobus*) and the red pine (*P. resinosa*), the two most valuable timber trees of Canada. The female *Monohammus* during the summer and autumn lays her eggs in crevices in the bark, both of the standing trees and of those which are dead and lying on the ground. The larva, after being hatched, soon acquires strength of mouth sufficient to enable it to work its way deeply into the wood. There it remains about a year, boring a long winding gallery nearly half an inch in diameter, sometimes into the very heart of the tree. As the time approaches for its final transformation it turns and works outwards towards the surface, just before reaching which it enters the chrysalis state. When the perfect beetle is developed, it soon, with its powerful mandibles, gains a passage for itself to the open air. I am of opinion that the insect does not come out as soon as the opening is made, for I have often seen them lying quite motionless in their burrows, with the head just peeping through. In this position the antennæ are not visible, as they are laid back on the sides of the body. On the 20th of July, 1860, while crossing Mount Royal, I noticed in a fallen pine tree

¹Jour. Acad. Nat. Sci., Phila., 2 sec., vol. 2, p. 148.

²Trans. Entom. Soc. Phila., i., p. 98.

³Canadian Journal, [1] iii, p. 212.

⁴Canadian Naturalist, V, p. 227.

⁵Canadian Journal [1], iii, 212. ⁶Ib., p. 326.

on the top of the mountain several burrows in the bark which had been lately opened and were empty. On further examination I found three others, with the head of a *M. confusor* filling each. On being touched they withdrew a short distance, but not out of sight. With the point of my geological hammer I soon stripped off the bark and extracted all three. It seems improbable (although it is possible) that they all arrived at the surface at the same time. It is more probable that after the opening is made the insect remains for a while, perhaps for a couple of days, in its burrow, until its elytra become consolidated. Although I have often found large white or yellowish larvæ deep in the body of pine trees, I have never been able to ascertain to what species they belonged. This and many other questions relating to the natural history of these insects remain to be decided by the researches of our entomologists.

These insects attack dead timber, and also trees which have received some injury and are in an unhealthy condition. I have never seen the female laying her eggs on a perfectly healthy and sound pine tree. Timber newly fallen is always attacked by them. The first dwellings constructed in the new settlements are generally made of logs with either the whole or a portion of the bark remaining on them. The inside is not plastered, except in the crevices between the logs; if these latter happen to be pine, the *Monohamus* lays her eggs in the bark on the outside of the house, and for months afterwards the larva may be heard in the stillness of night, making a noise like the boring of a small auger. The perfect insect sometimes comes out on the inside of the wall and suddenly drops down upon the floor, the table, or the bed, to the great consternation of the inmates, who imagine that an insect with such great horns must bite or sting with proportionate severity.

For the manufacture of boards or planks the pine trees are cut up into lengths of from 12 to 18 feet, and are either drawn or floated to the mill. The logs are got out during the winter, and if they remain in the mill-yard one season they are invariably found to be bored through in all directions by larvæ of these beetles and the boards greatly deteriorated in value. Where extensive operations are carried on a single lumberman will sometimes have a license giving him possession of over a hundred square miles of pine forest. In the months of May and June it often happens that great fires sweep through the woods, burning up all the fallen trees and dry branches strewn over the ground, and so scorching the living pines that most of them wither at the top and die during the season. Trees thus injured are soon after attacked by both the *M. confusor* and *M. scutellatus*, and within one year are so greatly bored that they are unfit for the manufacture of timber. Those experienced in the business, however, well understand the habits of the insect in this respect, and hasten to make the timber before it is destroyed. Pines scorched by the spring fires must be cut down and made into timber the next autumn. After one of these fires it generally happens there is a regular race between the lumberers and the beetles, the prize being a grove of white or red pine. I was told that Messrs. Egan & Co. lost £40,000 worth of timber by some unavoidable delay of a few months. Pine trees, when scorched, would be sound enough for timber five years afterwards if it were not for the attacks of these formidable destroyers.

Where there are only a few pines, as in the neighborhood of this city, it is rare to meet with more than one or two of these beetles together. But in the great forests of the Ottawa it is not unusual to find 15 or 20 on a single tree. On one occasion I saw an extraordinary number, and entered an account of the circumstance in my notebook on the spot. It was on the 11th day of September, 1857. I was at that time making some geological observations in the neighborhood of Lake Clear, in county of Renfrew. Following an old lumber-road through the woods, I came to a place which had been burned over some time during the preceding spring. There was one large white pine standing on the sunny side of a small, gently sloping hill. The height of this tree was about 120 feet, and its diameter nearly 3 feet. About 30 feet at the base was scorched. It was 60 feet to the lowest branch, and, as nearly as I could judge, the foliage for 20 feet at the very top had turned yellow. The remainder was green and apparently healthy. This tree was swarming with *M. confusor*, and many of the females were occupied in laying their eggs. I think there were at least 300 of both sexes, and I saw several flying from other trees 30 or 40 yards distant. In flying the body is not horizontal, but inclined at an angle of only 15° or 20° from the perpendicular. These insects were on all parts of the tree, and they did not take a firm hold of the bark, for a heavy blow with the hammer at the base would bring down a dozen at a time, some of them falling from near the top. When falling they do not attempt to fly. I had 50 or 60 crawling around me at once, and had a fine opportunity to observe the very considerable variations in the size of the individuals and the length of their antennæ. When two of them, going in opposite directions, met face to face, a clumsy kind of a fight took place, in which they reared and pushed against each other until one or the other fell over backwards. They bit each other with their mandibles, but with no effect that I could perceive. The females fought with each other or with the males indifferently. There can be little doubt but that this tree was, during the next twelve months, totally destroyed. If there were 150 females, and if each

laid 200 eggs, and half of these produced a healthy larva, then in one year this tree must have been perforated by 15,000 galleries. I examined other trees in the neighborhood, and on a few only did I see any of the beetles, usually from one to four or five on each. I can only account for the preference given to this particular tree by supposing that it was in a better condition for the nourishment of the larva than the others, and that the instinct of the females directed them to it. It is probable that nearly all the females for a considerable distance around were thus brought together on one tree, and were followed by the males.

I cannot say whether or not these insects ever attack a perfectly healthy and sound tree. I think they do not; and yet their ravages are certainly highly injurious to the commerce of this country, as they destroy a vast deal of fallen or scorched timber which otherwise might be brought to market at any time during several years after the trees have received their death-blow by fire or storm. I think also that thousands of trees, only sufficiently injured by fire to throw them for a while into a weakly or unhealthy condition, would recover were it not for the attacks of these formidable creatures.

The beetles of the genus *Monohammus* are, as is well known to entomologists, assisted by many species of other genera in the work of destroying pine trees. Canadian naturalists who have selected the wonders of the insect world for their study have before them a vast and little-wrought field. In an interesting paper on the trees of Canada, by our colleague, Mr. Robb, it is said that Canada produces "about seventy kinds of timber trees, of which at present we make profitable use of not more than eight or ten, the rest being left to decay. Her forests extend over about 360,000 square miles, and are unrivaled throughout the world for the variety of species, and more particularly for the size of the timber of full growth. Of sixty-four samples sent to the Paris exhibition of 1855, by Mr. Andrew Dickson, of Kingston, one-half were collected from an area of one hundred acres. The trees which we find most generally in our woods are the oak, beech, maple, ironwood, elm, birch, ash, pine, hemlock, tamarack, cedar, poplar, and basswood. All these trees attain to a considerable size, and grow to a greater or less extent in all parts of Canada, except on the coast of Labrador, where the only trees that thrive are the white birch, the fir, spruce, beech, and one of the varieties of pine. The trees of smaller growth common to all the country are the hickory, willow, alder, wild cherry, dogwood, sassafras, and a few others. The black walnut, tulip-tree, and chestnut are confined exclusively to the western peninsula. Oak and elm are more abundant and of better quality in Canada West than in the eastern part of the province, but all the other woods attain great perfection in Canada East."

Now, all these trees have their own species of insect persecutors. How many species prey upon each tree? When does each species deposit its eggs, and in what part of the tree? When is the larva produced, what is its form, and upon what part of the tree does it feed? How long does it remain in the larval state? What is the form of the chrysalis, and when does the imago appear? And, lastly, is there any method of protecting the tree? When all these questions shall have been answered, our entomologists, of which we have now a few good men and true, will have performed a great work. It seems almost impossible to protect a forest against an insect foe, but who knows what can be achieved by patient study? By accumulating facts, sooner or later a means of protection may be discovered. At all events, when our interests are threatened by an enemy, it is well to know all about him, his numerical strength, and the plan of his operations; without knowing these, we can never hope to discover his weak points.

10.—ENGLISH COMMON LAW IN RESPECT TO FIRES.

The liabilities from the setting of fires under the English law are thus defined by an approved author:¹

Every person who lights a fire is clothed by the common law with a heavy responsibility to his neighbors as regards the safe-keeping of such fire. By the ancient customs of the realm, "*quilibet homo et femina ignem suum, die et nocte, salve et secure custodiæ teneatur, ne pro defectu debitæ custodiæ ignis hujus modi damnum aliquod vicinis suis eveniat.*"² (Every person, whether man or woman, is under obligation to keep their fire safe and secure, both by day and by night, lest from some defect, due to the keeper, some injury may be done in its vicinity.) * * *

But although the master of a house or the raiser of a fire was clothed with this extensive responsibility as regards the lighting, safe-keeping, and spreading of such

¹ *Wrongs and their Remedies, being a treatise on the Law of Torts.* By C. G. Addison. 5th ed. (1879), p. 339.

² *Rostr. Entr.*, p. 18. *Parton v. Isham*, 3 Lev., 356; 1 Salk., 19.

fire, yet if the fire spread by reason of the act of God, or from some superior cause which could not have been prevented, controlled, or resisted by human agency, the master of the house or the lighter of the fire was held excused. Thus, where the defendant's servant kindled a fire in the defendant's field in the way of husbandry, and in the ordinary course of his employment as a farm servant, and the wind drove the fire into an adjoining heath and coppice of the plaintiff and set it on fire, it was held that if the defendant could have shown that the spreading of the fire had been occasioned by a sudden storm, which could not have been foreseen, guarded against, or controlled by human agency, that would be good evidence to excuse the defendant.¹

It was thought for a long time that the term "accidental," in connection with fires, was employed in the statutes in contradistinction with "willful," and that the same fire might be said to begin accidentally, and yet be the result of a certain amount of negligence; but it has since been held that these statutes refer only to fires produced by mere chance or which are incapable of being traced to any cause, and so stand opposed to the negligence of either servants or masters, and that they do not, consequently, protect persons from the ordinary common-law responsibility in respect to fires occasioned by negligence.²

Every person who puts a dangerous thing in motion which causes injury to another is, in general, responsible for the mischief it occasions.³

The English common-law decisions in reference to the responsibility for injuries from fire spreading to adjoining property are summed up as follows:⁴

If railway companies allow quantities of long dead grass, or any other combustible material dangerously to accumulate along their railway, and the combustible matter is ignited from lighted coals or sparks escaping from their locomotive engines, and the fire spreads from the railway to the adjoining coppices and fires them, the railway company will be responsible for the damage done; for such a fire is not a fire which accidentally begins on their estate, but is a fire caused by their negligence in not keeping the railway free from combustible materials liable to be ignited by their furnaces, and to cause damage to their neighbors; and they will be liable, although they could not not reasonably anticipate that such consequences would ensue from their negligence.⁵ They may be expressly authorized by statute to use locomotive furnaces of a dangerous character; but no statute can exempt them from the consequences of negligence in the management of their railways, or the construction of their fire-boxes, chimneys, or furnaces whereby coals of fire are thrown on the adjoining property. If they neglect to avail themselves of all such contrivances as are in known practical use to prevent the emission of sparks from their engines, they will be responsible for such neglect;⁶ and, if they run locomotives without statutable authority, in that case, they are responsible for any damage caused by such engines in setting fire to adjoining property or otherwise, although they have not been guilty of negligence.⁷

11.—FRENCH ORDINANCE AND CODE RELATING TO FOREST FIRES.

(a.) Ordinance of 1669.

TITLE 27, ART. 32. We also forbid all persons from carrying or kindling fire at any season of the year in our forests lands and heaths, as well as those belonging to communities and to individuals, under penalty of corporeal punishment and of an arbitrary fine, besides the damages that such fires may occasion, of which the communities and others, who have chosen the guards shall remain civilly responsible.⁸

¹*Tubervil v. Stamp*, 1. Salk., 13; 1 Ld. Raym., 264.

²*Pillitter v. Phippard*, 11 Q. B., 357. *Canterbury (Visct.) v. Att. Gen.*, 1 Phill., 328.

³*Vaughan v. Menlove*, 3 Bing., N. C., 468; 4 sec. 251.

⁴*Addison's Law of Torts*, 5th ed., p. 341.

⁵*Smith v. London & Southwestern Rail. Co.*, L. R., 5 C., p. 98; 6 *ib.*, 14; 40 L. J., C. P., 21.

⁶*Fremantle v. London & Northwestern Rail. Co.*, 10 C. B., N. S., 89, 31 L. J., C. P., 12. *Vaughan v. Toffhale Rail. Co.*, 3 H. & H., 743; 5 H. & N., 679; 28 L. J. Ex., 41; 29 L. J. Ex., 247.

⁷*Jones v. Festiniog Rail. Co.*, L. R., 3 Q. B., 733; 37 L. J., Q. B., 214.

⁸The law of September 25, 1791, reproduced this, with the substitution in place of the punishment of an obligation to pay the damages that the fire might occasion, and, according to circumstances, a further punishment of imprisonment. This became the foundation of article 148 of the present forest code, and of the existing provisions against willful and accidental fires, in the penal code.

(b.) Declaration of November, 1714.

[Regulating the penalties to be against those who through design or inadvertance set fire to forests lands, and heaths, whether belonging to the King or to individuals.]

LOUIS, by the Grace of God, King of France and Navarre: To all to whom these presents shall come, greeting:

We have by Article XXXII, of Title XXVII, of our ordinance of the month of August, 1669, forbidden all persons from carrying fire, or from kindling fire in our forests, lands, and heaths, and in those of communities and of individuals, under pain of corporeal punishment, and as the quality of corporeal pains that should be ordered in these cases are not defined in this article, we have been informed that several judges of woods and waters have found themselves often embarrassed as to the degree of penalties that should be pronounced against those who violate the prohibitions of this article; and it being important that all doubt should be removed on this point, we have resolved to explain precisely the quality of the penalties to which the judges ought to condemn, and we have at the same time deemed it proper to declare the penalties that ought to be thus ordered against those who set fire in lands and heaths, and in other places of the forests, because we have learned that although these penalties are expressly declared in the ordinances of the Kings, our predecessors, some pretend that they have been abrogated under pretext that we have not recalled the provisions of the said ordinance of 1669, for which reasons we have deemed it all the more necessary to explain our intentions, since the frequent fires that are happening in some one of our forests and in those of communities and individuals oblige us to redouble our care for the preservation of the woods and forests of our kingdom, which have suffered a great loss during the late war. For these and other causes to us knowing we by our certain knowledge, full power, and royal authority, have and do, by these presents signed by our hand, say, declare, and ordain, that husbandmen and all others who shall be convicted of having carried fire, or to have kindled fires in our forests, lands, and heaths, as well as those owned by communities and individuals, or of having made a fire within a quarter of a league of such woods, lands, or heaths, shall be punished by whipping, or for a second offense shall be sent to the gallows. We further will, that those who, with premeditated design, set fire to woods, lands, and heaths, or to other places in said woods and forests, shall be punished by death. And further, that all those who have been convicted shall, besides such penalties, be fined arbitrarily by our judges to pay the damages and interests that have been injured to proprietors of the said woods. And, we enjoin on the officers of waters and forests, to make frequent tours both by day and by night, by the sergeants and forest guards, to prevent the occurrence of these disorders, giving to our friends and faithful counsellors, and to our court of parliament in Paris, to make the present declaration known, read, published, registered, and executed, according to its form and tenor, for this is our pleasure.

In witness whereof, &c., &c.

LOUIS.

(c.) Code Forestière (1827).

ART. 143. It is forbidden to carry or kindle fire within the woods or forests or within 200 meters of the borders, under a penalty of 20 to 100 francs, besides the penalties provided in the penal code, and all rights for damages to private interests, if any occur.

ART. 149. All persons holding rights of usage who, in case of fire, refuse to bring aid in the woods under their right of enjoyment, shall be turned over to the correctional police and be deprived of these rights for not less than one and not more than five years, and shall be further subject to the penalties mentioned in Article 475 of the Penal Code.¹

¹The provisions of the Penal Code above referred to is as follows:

ART. 475. There shall be punished by a fine not less than six nor more than ten francs, the following persons. * * * 12th. Those who may refuse or neglect to work, do service, or bring aid when requested so to do in times of accident, tumults, shipwreck, inundation, fire or other calamities, as well as in case of robbery, pillage open crime, public outcry, or the execution of justice.

ART. 458, of the Penal Code provides as follows:

"The burning of property, whether real or personal, belonging to another, whether from the decay or neglect to repair or to clean any ovens, chimneys, forges, houses, or shops adjoining, or from fires kindled in the fields, at less than a hundred meters from houses, buildings, forests, heaths, woods, orchards, plantations, hedges, mills, stocks of grain, straw or forage, or any other combustible materials, or by fires or lights carried or left without adequate precaution or by fire-works kindled or set off through negligence or carelessness, shall be punished by a fine of not less than fifty nor more than one hundred francs,

12.—SPANISH REGULATIONS CONCERNING FOREST FIRES.

(Circular of May 5, 1881.)

His Excellency the Minister of Agriculture has communicated to me under this date the following royal order :

SIR: One of the causes that has contributed most powerfully to the destruction of our forests is that of fires. Although sometimes arising from accident, or as the unintentional result of irregular and often criminal carelessness in the burning off of stubble, or the dry herbage on vacant pasturelands, or the bushes in the forests, they are much oftener caused by perverse design, and with the view of getting a little benefit from the growth of sprouts and fresh herbage on the burned surface, but in a little while converting into great sterile deserts, lands that formerly fertile, and abounding in animal and vegetable life.

These deplorable abuses urgently demand the most effectual and active remedies, in order to put an end to these immense and overwhelming damages that are causing the destruction of our forest riches, and this the more urgently, since sad experience has made us feel the benefits that woodlands confer.

We therefore urge you to redouble your diligence, in acting promptly and in the place where these catastrophes occur, by prosecuting and punishing with a strong hand the persons who cause these damages. If nothing more was done than to establish convenient stations for observation upon the highest points of land, from which the whole or a greater part of the forests might be overlooked, and to place persons there in readiness to hasten promptly to the extinction of fires, this would be of itself in most cases, sufficient to prevent the damages from these fires, by bringing aid in time to check or restrain them in the beginning.

But it is certain that the most active vigilance is not enough many times to prevent an evil that is so easy to produce. Excepting when the conditions of the locality and the time favor, these fires cannot be seen by those watching for them, beyond a short distance, and the force at hand may often be quite inadequate for their control. In such cases there is no other remedy than to call promptly to the service a strong force, and for this purpose it is necessary that the mayors should act promptly in calling aid immediately into action.

Various means may be employed to attain this end, and it is impossible to decide beforehand, where so much depends upon circumstances.

The principal bodies of our forests are almost always remote from considerable centers of population, and placed under orographic conditions that would, as a general rule, hinder the employment of such a network of telegraphs as would be necessary for the occasion, even although the older and ruder apparatus were employed. This would not, however, prevent their use in certain localities that present appropriate conditions, such as are found in the Sierra Bermeja and La Torrecilla, in the province of Malaga, the center of great masses of forest, or in the forests of Zuerra de Zaragoza, or at various points in Castellon, Soria, Cuenca, Cadiz, Granada, Navarra, Valencia, and Segovia, where it would be convenient to adopt either the optical or the electrical systems, or both combined, but always joined with a personal vigilance that shall bring aid on the first instant to the extinguishment of fires. Fortunately the government has under existing provisions, the means necessary for satisfying so important a measure.

To the end that measures may be adopted for securing this end, it has pleased His Majesty, the King, to decree as follows:

ARTICLE 1. The general direction of agriculture, industry, and commerce, upon previous examination of the forest districts shall fix the number of temporary fire-watchmen that should be employed, and shall appoint them for the months of July, August, and September.

ART. 2. The nomination of these guards shall be made by the chief engineers of the districts, preference being always given, where possible, to persons of approved capacity and intelligence.

ART. 3. Stations should be formed upon the most elevated points, from which a wide area of the surrounding country may be observed.

ART. 4. In woodlands, where the danger from fires is the greatest, a larger number of watchmen shall be employed.

ART. 5. The governors shall especially charge the local authorities, civil guards, rural guards, and agents of the public safety, to indicate the places that they regard as the most exposed.

ART. 6. The civil guards in their districts shall, in spring and autumn, watch with greater care and frequency the places of stopping and passing, of shepherds, woodcutters, sawyers and others who pass through the forests or work permanently in them.

ART. 7. Overseers of cultivation who are so situated that they can readily observe

the forests, shall have constant watch over their charge, and watch with more care the places where fires are most liable to break out. Upon the adoption of any new changes, they shall immediately take measures for preventing dangers, as soon as they come to their knowledge.

ART. 8. The engineers and their assistants shall visit all the localities, that they are required to examine, and inspect thoroughly the service.

ART. 9. All assistants, as well as civil guards, and all persons employed in the forest service, shall, with the greatest attention, and under the strictest responsibility, watch over the exact observance of the existing regulations, in regard to the police of the forests, with the view of preventing forest fires, and especially article 149 of the ordinances, that prohibits the carrying or kindling of fires in a woodland, or within 180 metres of its borders, under the penalties therein mentioned.

ART. 10. Whenever there is an absolute necessity of kindling a fire in the forests, the place shall be designated by the overseers, and a trench not less than a meter in depth shall be dug around the same.

ART. 11. The engineers and assistants shall designate the places that they may deem most convenient, for depositing the axes, mattocks, panniers, and other articles most useful in controlling fires.

ART. 12. Vacant belts and fire-guards shall be made of proper width, and in places most convenient for preventing the spread of fires.

ART. 13. In every place where a fire has been declared, the engineer shall direct the measures that he may deem necessary for extinguishing it; or if he be not present, then the assistants, the overseers, and the civil guards. All the employees of the service, public servants, and whoever is concerned in the said operations, shall be subject to the command, and shall comply strictly with the orders of the person who may be in charge.

ART. 14. Whenever any person shall observe a fire, he shall give immediate notice to the employees of the service, civil guards, and local authorities, and those who should act shall immediately announce the same by means of the usual signals previously agreed upon; when all those who are required shall at once assist in extinguishing it.

ART. 15. An effort shall be especially made to limit the fire, by isolating it within a definite space, by means of the vacant lands or fire-guards, and by adopting the most speedy and effectual methods for completely extinguishing it, notice being taken of the direction and force of the wind at the time.

ART. 16. After a fire has been extinguished, the woods must be watched with great care, to prevent its renewal, or breaking out at any place.

ART. 17. The employees of the service upon the outbreak of any fire within their district shall notice the point where it began, and the manner in which it escaped, as also the day and hours when it was discovered, and the progress that it had made when first seen.

ART. 18. Upon the occurrence of every fire in the forest, the greatest diligence shall always be shown, to clearly ascertain the causes that started it, as also to arrest the guilty parties if known, bringing them before a competent tribunal with as little delay as may be in order that they may be punished for the results of their delinquency.

ART. 19. Those who hold any rights of usage, or any privileges in a burning forest, who do not hasten to assist in extinguishing the fire when called upon, shall be deprived of their rights for a time determined in article 150 of the ordinances.

ART. 20. The forests overrun by fire shall be rigorously inspected in conformity with the provisions in the royal circular order of January 20, 1847, in order that its condition may be exactly known in every part.

ART. 21. After the extinguishment of a forest fire, prompt measures shall be taken for verifying the trees that are injured by the fire, and for their removal and use for the best purposes to which they may be applied.

ART. 22. In the same manner measures shall be taken as found expedient for the replanting of forests that have been destroyed by fire.

ART. 23. Within as brief a time as possible, and not to exceed eight days, the governors shall inform the ministry of agriculture, as provided by royal circular order of June 24, 1848, of every fire that may have occurred in the forests. The said report shall show from the data furnished for the purpose, a circumstantial account of the occurrence, omitting nothing upon the following points:

- (1.) The area of woodlands burned.
- (2.) The cause of the fire.
- (3.) The hour and the point where it began, and where it was extinguished.
- (4.) A description of the practical operations and means employed for extinguishing it.
- (5.) An approximate calculation of the number, quantity, and value of products consumed, and of the destruction and injuries done.
- (6.) The number, quantity, and value of products touched by the fire that may be saved.

(7.) The behavior of those who hastened to extinguish the fire, specifying all those who distinguished themselves therein, as also those who did not attend when called upon, and who were under obligations to do so, in order that the former may receive the reward, and the latter the correction that they deserve.

(8.) The tribunal that gave a hearing to the case.

(9.) The measures adopted under the instructions of the officer reporting, relating to—

- (1.) The investigation of delinquencies ;
- (2.) The sale of damaged products ; and,
- (3.) The replanting of the woodland.

ART. 24. The engineers shall prepare and transmit in the month of May the data prescribed in Article 1.

ART. 25. The chiefs of the forest districts of Malaga, Zaragoza, Castellon, Soria, Cuenca, Cadiz, Granada, Navarra, Valencia, and Segovia shall accompany the above report, a project for protection and detailed estimates concerning the kind of telegraphic signals that might be established most conveniently within their several jurisdictions, particular reference being had therein to the extent and importance of their forests. Upon the approval of these projects, the engineers shall adopt the necessary measures for their establishment, so that they may be in readiness to operate by the 1st day of July following.

ART. 26. The day-wages of the temporary watchmen, and other charges that may arise from this service, may be paid out of the credit granted for the improvement and extension of telegraphs by Chapter 19, Art. 2, of the appropriation for the service of the ministry.

The regulations concerning forest fires in force before the preceding were issued date from July 12, 1858, provided for the appointment of forest guards, the establishment of stations, the summoning of aid in case of fires, the inspection of damages, and an early report of details, very much the same as in those of 1881. It did not, however, include the systems of telegraphic signals in certain regions, as are now provided.

Law of Baden for guarding against Fires.

When charcoal is made in the woods, the place shall be designated by the forester in charge. The surface around the coaling place must be at least fifteen paces distant from the branches of the nearest tree, and at a distance of four paces from the ground all combustible materials shall be removed. The pace, as used in this connection, shall be taken as equal to two feet and a half.

The coal-burner is bound to notify the forester or forest agent of the time when he intends to set his meiler on fire. After the fire has been applied he must never at any time allow it to be left alone by day or night, and he must at all times have a supply of water near for immediate use.

In stormy weather he must put up some wind-screen in such a way that the meiler shall not be exposed, and that no coals be blown away. No coal shall be removed at any time, until after a lapse of twenty-four hours after the burning is finished.

The above rules likewise apply to the burning for ashes.

Within the woods, or within fifty paces thereof, and on the surrounding moorlands, it is also strictly forbidden to use any fires without notifying the forester in charge and taking proper precautions against their spreading.

The following are included in the above prohibition:

(a.) The fires which the forest guards in their several districts, the wood-cutters in their allotments, or workmen in stone-quarries may have occasion to kindle for cooking or warming, which fires may only be made in places previously designated and prepared.

(b.) The fires which are set for burning roots and in clearing of the ground in preparing it for field culture. In these it is to be seen to

that the fires in the woods are not less than ten paces from the standing trees and the ripened timber, and this interval must be cleared away.

The kindling of a running fire in a clearing is forbidden; nevertheless at a proper time the forest officer in charge, and the burgomaster may, at their discretion, authorize the same.

The forest guards, wood-cutters, quarrymen, and others above mentioned, when they have occasion to make a fire in the woods or near it, are bound to extinguish the same before leaving it.

The burning of tar or limekilns may not be allowed in any place nearer than fifty paces from the borders of a woodland.

Upon the proceedings to be had in case of forest fires, the regulations are elsewhere stated.

14.—FOREST FIRES IN FINLAND.

Of all people in Europe the Finns are perhaps most addicted to the setting of forest fires. It is a custom that they brought with them from Asia, some centuries ago, and it forms a part of a system of cultivation that is practiced to a large extent in Northern Europe.

The woods are cut down, and allowed to get dry. They are then burned off, and rye or barley is sown the first year, and oats the next. The ground is then left to grow up to a second growth of wood, generally the white birch and the alder, until thirty years old; by which time the fertility of the soil has been renewed sufficiently for another cropping as before.

In the southern part of the country, where the land is of better quality, this custom has been abandoned; but in stony regions in the interior at least 50,000 hectares (about 124,000 acres) are thus annually burned. The Government has tried to stop the practice, and a recent restriction has been promulgated upon the subject. It is found difficult, however, to enforce the regulation, more especially upon private lands, where it is deemed the only means of rendering cultivation available.

Fire is also used as an agency in agriculture by burning off moorlands for cultivation, and for improving the pasturage. The carelessness of herdsmen, hunters, fishermen, and travelers often causes great injuries, and more rarely they are set through malevolence.

In 1880 considerable fires prevailed in the Crown forests, having escaped from private lands, but the means employed for controlling these fires generally limit their extent. The means of control are better organized in the southern part of the country, where the average district under one guard is not over 3,000 hectares; but in the northern part, where they sometimes embrace 50,000 hectares, a fire may get beyond control, especially in a dry season, when the flames run up into the tree tops, and are carried along before a strong gale of wind. In such a case they must run till they spend themselves, and there is nothing left to burn. In systematically defending a forest against an advancing fire, two lines of men are placed in the woods; one of which looks after the falling cinders, and beats out the fires they kindle with pine bushes or other means at hand, while another line with axes hastily clears a space for back-firing. During the past summer (1880) a fire that had got fully under way in the Crown forests was thus subdued. In five hours it traveled four versts (—) and overran some 2,000 acres. On the first day 80 men were employed, and for a week afterwards half a dozen more to watch the woods and prevent any revival

of the fires. The laws in Finland in regard to forest fires are the same as in Sweden, and in case of an alarm each family is obliged to furnish one man for the work.

15.—FOREST FIRES IN STYRIA.

In a paper entitled "Notes on Styrian Forests," by Samuel Noble of Alabama,¹ the following notice is made of forest fires:

The trees (spruce-pine) are planted so thick that when they grow up they effectually shade the ground; the branches underlock each other; the light of the sun cannot penetrate. Left for one hundred years without cutting, they grow from 14 to 18 inches in diameter; a tree to every three or four square yards of land. The soil beneath is a mass of decayed vegetation, the accumulation of leaves, cones, and rank vegetation of grasses and ferns that spring up from the wet and densely-shaded ground; hence forest fires are very destructive, and are regarded as a public calamity. It destroys all the young trees, baking and burning up the soil, destroying all vegetable matter, and making it almost impossible to re-establish the growth.

The laws against firing forests are very stringent—ten years' penal servitude. It is regarded as a greater crime than burning buildings. Every precaution is taken to keep fires from breaking out, so that they very rarely occur.

16.—FOREST FIRES IN ALGERIA.

The forests of Algeria have been repeatedly ravaged by fires, which, in the draught and heat of that country, will rage with great energy when once started. These fires were very destructive in 1860, 1863, 1864, 1865, and 1873. From their simultaneous appearance in 1865 at many remote points, the belief became general that they were set by incendiaries having a concerted plan previously arranged, and as was supposed by the Arabs, through jealousy of the Europeans, who had undertaken contracts for working the cork-oak of the country. These contractors had invested a hundred millions of francs in this business. As an illustration of the fanaticism of the natives in reference to this subject, it is shown by official records, that on the morning of the 25th of August, 1865, a fire broke out in the bushes by the side of a public highway, when a number of the natives hastened to the place, and soon succeeded in getting it under control.

One of them, Mohamad Ben Arba, then proposed to set fire to the dwarf palms on the estate of the family Ben Hessah, and in spite of the earnest remonstrances of his co-religionists as to the dangerous consequences that might follow, he seized a rod, kindled it in the embers of the fire already subdued, and set fire to the palms above mentioned. The fire, fanned by the south wind, quickly spread with fearful energy upon the zaonia, or undivided property of the family, devouring, besides palms and bushes, a large quantity of great trees (lentiscus, evergreen oaks, and olives), a small grove of Aleppo pines, a dwelling occupied by a Spaniard, and a dozen other dwellings inhabited by members of the family Ben Hessah, and finally the catafalque and the internal ornaments of the marabout attached to the family.

The accused was condemned to hard labor for life, and another fanatic who had been concerned in firing the woods was condemned to death.

A commission was appointed to examine the question of forest fires and study the means by which their danger could be lessened, or their occurrence prevented, as also to advise as to the claims for damages to the contractors that should be allowed by the government. Their report passed in review the various causes to which these fires might be attributed, and proved that no theory of spontaneous combustion or of, carelessness was sufficient to explain them. In short, it was necessary to ascribe it to the malevolence of the natives, and the result of political and religious fanaticism, the seat of which was in Mecca, and which,

¹*Journal of the United States Association of Charcoal Iron Workers*, vol. ii, p. 33.

at various times since 1856, had too often been felt where Christians had been brought in contact with a Mussulman population. The report expressed the opinion that the state should assure the contractors against these fires and the damages that they had occasioned, and which could not be valued at less than \$18,000,000 in the years 1860 to 1865.

Finally they appealed to the government in the future to provide absolute security so far as its power would enable it to do, and declared that without this no grant of privilege could thereafter be enjoyed. This security appeared to be easy of attainment by the enforcement of rigorous laws, and especially those already in force in Algeria, among which may be cited the law holding the native tribes collectively accountable for the fires that might happen, besides holding the guilty persons personally punishable when found.

In 1873 these periodical fires in Algeria had become so intensely destructive that the government again appointed a commission to devise the means for preventing the return of these disasters. This commission recognized the necessity of a law authorizing the government to impose upon the population, in the region where these fires occurred, such measures of repression and accountability as might be deemed effectual.

17.—FOREST FIRES IN INDIA.

Dr. Schlich, in reporting the forest work in Sind, for 1871-'72, says:

Fires are very rare in Lower and Middle Sind, but very frequent in Upper Sind. A careful examination of all the forests in Rohri, Guhla, and Sakkhar Rangers, shows that for many years past about one-fourth of the whole area has been overrun by fires annually, whereby large tracts of forest have been destroyed, which contain now nothing but grass and small shoots of lai. There is no doubt that the greater portion of these lands will be covered with forest again, if the fires are kept out, and this is of the greatest importance, as the forests will otherwise fail in furnishing the fuel required by the steam flotillas, and the proposed Indus Valley Railway.

Almost all these fires are ignited by cattle owners, with the view of obtaining a new crop of grass. In order to prevent or reduce the occurrence of conflagrations, all cattle owners have been compelled to live outside, or just on the boundary of the forests. In addition, the laying out of a system of fire-paths has been commenced, and during the last two years a total of 35½ miles of roads, 20 feet broad, has been constructed in the Sakkhar Range, whereby the Abad and Aliwahan subranges, comprising an area, of 39,999 acres, have been divided into compartments of about one square mile each. During the next few years this net of roads will be extended over the whole of the forests in Upper Sind.

All forest officials have received strict orders to report every fire that takes place so that they are obliged to give the subject their constant attention. This measure, as been very beneficial, as it has resulted in a very extensive reduction of fires; moreover almost all the fires in the Sakkhar Range have been arrested by the new fire-paths.

During the year reported 36 fires had been reported, and the area burned was 1,590 acres. In eight prosecutions two convictions were obtained, one resulting in fine and the other in imprisonment. One fire was started by a hunting excursion, and one by an overseer of public works. Several blocks had been closed against cattle for a year, so that the owners would get no benefit from the new grass.¹

The experience of the next year tended to show that these openings of 20 feet were not wide enough to check a fire when a strong wind was blowing, but that they were nevertheless useful, inasmuch as they open out the forests and make them easier of inspection. Objections were raised against the plan of closing the forests against cattle, from the loss of revenue that resulted, but these were not sustained by superior

¹*Administration Reports of the Forest Administration in the Bombay Presidency, for 1871-'72, p. 58.*

authority as these fires were often started by herdsmen, and the exclusion of cattle would be a removal of natives.

As a further means for checking fires a trial was recommended for eradicating certain grasses by burning at a proper time, and cultivating a year.¹

Fire-paths, cleared 20 feet wide, however convenient as lines for access and inspection, have been found too narrow to prevent the fire from crossing in a windy time. Their widening has been recommended to 50 feet, and in one instance a single fire-path around one reserve in India measures 174 miles long and 300 yards wide.² This requires the constant clearing of 19,000 acres of land. It is suggested that strong, deep, evergreen hedges of prickly pear, intermixed with bamboos, American aloe, and trees, would serve the purpose better at less expense. This idea was condemned as dangerous and impracticable by superior authority.

Great advantage has been realized by enlisting the services of the villagers to guard against the occurrence of fires and to extinguish them when begun. The conservator of the northern division of the Bombay Presidency, in speaking of the causes and prevention of fires, says:

The great keystone towards securing the prevention of fire, as well as the maintenance of conservancy, is the good-will of the villagers living on the borders of the forests, and every reasonable endeavor should be directed towards enlisting their co-operation in the interests of forests.

The *Panicum specabile* is found in that region to be a grass that will grow in the dryest and hottest places; it grows to a height of 3 or 4 feet, has deep, strong roots, is very sweet and succulent, and is always green; the fire will not travel across it.

Among the pests of the forests of India are *creepers* that choke and strangle the young trees, and encumber the larger timber, and the *prickly pears*, which so persistently spreads through the forest as to seriously hinder its working and obstruct its growth. The eradication of these, the former by cutting and releasing and the latter by uprooting and burning when dry, form a constant and ever recurring cause of expense. If part of the roots are left the plant reappears and spreads again until it becomes as thrifty as before.

The prickly pear of India is a native of Brazil, and was introduced a century and a half ago. Its rapid spread is due to the birds being fond of the seed. It was formerly thought to be of no use whatever, but it is now found that certain tree seeds germinate very quickly in its ashes and that the plant itself is very valuable as a manure. For this use it is thrown into a tank (pond) through which water for irrigation passes, and, as it decomposes, the gases absorbed by the water and the half-decayed tissues afford the best fertilizing qualities to the water that is being conveyed to the plants under cultivation. It is also found serviceable in preventing the entrance of fires where allowed to grow as a hedge in dense masses on the borders of a forest.³

The reckless improvidence from burning off forest lands for temporary cultivation is shown in a report of the forest service in India, in which it is remarked:

It must be the endeavor of the department to cover the hills with any kind of shrub which will do for fire-wood. I am afraid the hills will never produce any trees of a superior description. The want of any kind of vegetation results in scanty rainfall and periodical famines. * * *

¹*Ib.*, 1872-'73, p. 83.

²*Forest Report*: Bombay, 1874-'75, p. 51.

³*Administration Reports of the Forest Department in the Bombay Presidency*, for 1874-'75, p. 49, 50.

No system of cultivation is more destructive to forests, detrimental to the prosperity of the country, and demoralizing in its effects on the people who subsist under it, than koomrie. The trees growing on the steep slopes of hills are cut clean off, not a stem being spared; the whole is then burnt lying on the ground, and two, or at most three scanty crops of very inferior grain are produced by sowing seeds in the ashes. After this the ground is abandoned, the cultivator refusing to pay assessment for the land that he has converted into a barren waste, and new forest land is taken up elsewhere to be similarly treated.

The cultivation of the very inferior grains raised on the smoldering ashes of rich forests deserves no encouragement.¹

In semi-tropical countries a luxuriant undergrowth is among the most prominent agency for carrying fires through a forest. This is shown in the Upper Sinde, in the Presidency of Bombay, in India, where the flood waters lie deep and long, and the vegetation is very rank. The Administration Report of the Forest Department for 1873-'74 (p. 134), in describing this condition, says:

A very large proportion of the Upper Sinde is covered with a dense mass of grass and reeds, 10 to 12 feet high, through which tamarisk and poplar strive to fight their way up to the light and air. If fires were kept out for a series of years the trees would in all probability overlap the grass, exclude the air from it, and so cause its destruction. But as long as fires occur annually this will be impossible. When the grass is ignited it burns very fiercely, and trees and grass are burnt together. Within a year the grass has grown up to its former height; on the other hand, most of the trees have been killed, and those whose roots or stumps have survived have only been able to throw out small shoots. Then the struggle between grass and trees begins again, with the odds much in favor of the grass.

The only remedy appeared to consist of thorough cleaning out and stocking it with "tali" (*Dalbergia sisso*), a costly process, but one that was thought to be remunerative. This tree grows rapidly, is never injured by the frost, and is valuable both as timber and as fire-wood.

18.—LAW FOR PREVENTION OF FOREST FIRES IN THE COLONY OF VICTORIA.

AN ACT to consolidate the Law relating to the Management of Towns and other Populous Places, and for the suppression of various Offences. (Assented to June 6, 1865.)

SEC. 21.² If any person shall (except as hereinafter mentioned) ignite or use or carry when ignited any inflammable material within twenty yards of any growing crops or stack of corn pulse or hay, or within three yards of any stubble field or grass land, and thereby the property of any other person shall be injured or destroyed, or if any person shall leave any fire which he may have lighted or used in the open air before the same be thoroughly extinguished, he shall forfeit and pay for every such offence any sum not exceeding one hundred pounds, or be imprisoned with or without hard labor for any period not exceeding six months: *Provided*, That it shall be lawful for the occupier of any land to burn any straw stubble, grass, or herbage, or to ignite any wood or other inflammable material on such land, after he shall have cleared of inflammable substance, a space of land around the straw, stubble, grass, or herbage intended to be burnt, or wood or other inflammable material intended to be ignited, of not less than fifteen feet in breadth, and after he shall have given to the occupiers of all land contiguous to the land from or on which the straw, stubble, grass, or herbage is intended to be burnt, or inflammable material to be ignited, notice in writing at least twenty-four hours before burning or ignited as aforesaid of the time at which it is his intention to burn or ignite: *Provided further*, That it shall be lawful for the occupier of any grass lands, between the hours of two of the clock in the afternoon and nine of the clock in the afternoon to burn off any grass or herbage from any such land in his occupation, after giving the like notice in writing as hereinbefore directed, of his intention so to do, to the occupiers of all land contiguous to the land from which the grass or herbage is intended to be burned, and after having drawn plough furrows for a width of not less than three feet on either side of such grass or herbage: *Provided, also*, That nothing in this section contained shall be taken to apply to any place within the operation of any act now or hereafter in force for regulating buildings and party walls in the city of Melbourne.

¹Administration Reports of the Forest Department in the Bombay Presidency, for the year 572-'73, p. 5.

²Statutes of Victoria, 1874, page 2079, sec. 21.

19.—INSURANCE AGAINST FOREST FIRES.

Some years since several of the fire insurance companies in France were accustomed to issue policies of insurance against the injury or destruction of forests by fire, more particularly in the newly seeded pine forests of the "Landes" of Gascogne. The frequent and disastrous fires that occurred in that region in 1869 and 1870 led them generally to withdraw from this line of business, as the risks were found to be greater than could be afforded at the rates that were charged, and in fact more than could be calculated beforehand.

The private woodlands in that region mostly belonged to large estates, and the idea occurred to these proprietors that a mutual fire insurance company might be organized among themselves, against losses from fire. The project was favorably received by many, and articles of association were drawn up for the incorporation, which was to take the name of the "*Union Forestière*," whose operations should be limited to insurance on the mutual plan, of resinous and non-resinous forests within the departments of Gironde, Landes, Lot-et-Garonne and Charentes, and whose principal seat of business should be at Bordeaux.

In a letter addressed to the prefects of the departments, with the view of obtaining their official approval by way of encouragement, they say :

This company, gentlemen, of which the statutes have been distributed, is no speculation of any men who have taken up the project with no idea beyond some limited and personal interest, as an affair that may survive or perish, as may happen ; it is an association of proprietors adopted upon the broad basis of mutuality, for protecting one another as much as possible against the unequal chances of a calamity that may befall them, and which in their present isolated condition may at any time ruin some, while others are spared. Sixty-three of the principal proprietors of woodlands, representing more than five millions of the property to be insured, have given in their acceptance of our statutes, and others in the department must inevitably follow them. They are at this moment obtaining the assent of others in the department of Landes, and it is in the highest degree probable that the amount subscribed there, added to that in Gironde, will be sufficient to reach, if it does not exceed, the ten millions of francs, fixed as the minimum for the beginning of the mutual insurance company.

Upon attentively reading these statutes it will be seen that the combination proposed bears evidence of great prudence in their character, and that they have for their object to prevent, in case of immense disaster far exceeding any expectations, the operation beyond a certain limit, which the associated proprietors might not be called upon to meet by assessment, and which they might not wish to exceed. It is in fact a mutual fire-insurance company, with a limited responsibility upon each one of its members.

The authors of this useful foundation have a desire to raise and strengthen the courage of proprietors, and at the same time to increase the money value of property of this kind, and the measure would doubtless lead to the favoring of general provisions for preventing and controlling fires. They therefore respectfully request that the project be considered by the General Council, and that the Council will, by a favoring vote, express its sympathies in the proposed enterprise thus presented. This action would be regarded as a precious evidence of your favor, and it would tend to strengthen our efforts and perhaps prove an element of success.

The vote of approbation was adopted unanimously, as desired, but the events which followed put a stop for the time to all further efforts towards the completion of the plan. It was taken up again in 1872, and on the 8th of April of that year definitely organized upon a broader basis than had been proposed in 1869.

The first article of these statutes declares that the *Union Forestière* is formed as a mutual fire-insurance company, for protection against the risk of fires in resinous and non-resinous forests in France and Algeria.

The proprietors thus associated for mutual insurance agree to pay

for losses resulting from fires in resinous woods a rate that shall not exceed the following:

| | Per cent. |
|---|-----------|
| For woods under fifteen years of age..... | 12 |
| For woods from fifteen to twenty-five years of age..... | 6 |
| For woods from twenty-five to thirty-five years of age..... | 3 |
| For woods of thirty-five years of age and upwards..... | 1½ |

These rates are the maxima, which may be lowered either on account of given circumstances or after a certain experimental period.

According to estimates made at the time a general plan of Forest insurance was under discussion, there were in France more than a million of hectares of resinous forests (nearly two and a half million acres), having an average value of 500 francs per hectare. It was assumed that half of this quantity could be insured at a premium of 2 or 2½ francs per 1,000, or 1 to 1½ francs to the acre. The average loss per annum for the last twenty years was stated as having been 100,000 francs.

In 1868 the loss was much greater, and in Russia it was very serious. It was admitted that in very dry seasons, the risks might greatly exceed the estimates, and that opportunities for fraudulent fires would be greater than in common insurance.

We learn from M. Armand Fleury, General Manager of Insurance, Paris, that at the time of writing (May, 1881) insurances are currently accepted by nearly all fire-insurance companies in France against losses by forest fires. The rates are based upon the ages and the more or less resinous quality of the wood, and if the forests are traversed by railroads they are considerably increased.

There are no Special Companies for Forest-Insurance in Europe. There have been some mutual companies, but it is understood that none now exist.

From a circular giving the rates of Agricultural Insurance, and of insurance against fire, issued by the general office (Nos. 28 and 30 Rue de Grammont, Paris), we find standing timber classified at the following rates of insurance per annum for 1,000 francs:

| <i>Non-resinous standing woods:</i> | Francs. |
|---|---------|
| Over twenty-five years old | 0.40 |
| Under twenty-five years old..... | 0.75 |
| <i>Resinous standing woods:</i> | |
| Pines, fifty years old and upwards | 1.00 |
| Pines, fifty years or over, mixed with younger trees..... | 1.50 |
| Pines, thirty to fifty years old | 2.50 |
| Pines, fifteen to thirty years old..... | 3.50 |
| Pines, ten to fifteen years old..... | 5.00 |
| Pines, under ten years old | 10.00 |

In all cases the agents are to consult the company before concluding the insurance. Wood, if non-resinous, may be insured while in course of cutting, if not in a saw-mill or connected with an industry that increases the risk by fire, at 2 francs per 1,000. Wood-yards, ship-yards, saw-mill stock, charcoal, &c., are also subjects for insurance at rates depending upon the risk, and varying from 60 centimes to 2 francs for one year for 1,000 francs in value.

The instructions issued to agents for insurance of woods and forests are as follows:

The premiums for standing non-resinous woods are fixed at 75 centimes for trees over twenty-five years old, and at 75 centimes for trees of younger age, but these rates do not apply to Algeria. You may allow the presence of 10 per cent. of resinous trees without increasing these rates, if uniformly distributed through the forest. The following clauses should be inserted in policies for insurance of woods and forests:

The company insures M. ——— for the sum of ——— upon woods standing and not felled, not including the stumps and brush, otherwise called underwood, composing the woods known as ———, containing about ——— hectares, sloping towards the east ———, to the west ———, to the south ———, and to the north ———, and situated in the commune of ———.

●M. ——— declares: (1). That the said woods are being *amenaged* on a period of ——— years; and that the principal kinds are ———, ———, ———. (2). That they contain no resinous species, or, at most, that there are not more than one-tenth of resinous species, and this part uniformly distributed throughout the woodland. (3). That there are within the said woods no mills nor manufactories of charcoal, wooden shoes, or boards, nor buildings for holding merchandise specified as hazardous on the company's list of charges.

It is furthermore understood:

1. That the person insured is required to report immediately any changes that may affect the period of *amenagement* declared, in which case the company reserves the right of canceling the policy. In default of this notice the insured will, in case of a fire, have no right to claim damages.

2. In case of a fire the adjusters will take as the basis of their estimate of coppices, the prices of sales, or of regular cuttings, as they were quoted on the day of the accident; or in the absence of such sales or regular cuttings, the estimate shall be upon the usual price at that age. In either case the amount shall be divided by the number of years of the period to obtain the value per hectare of each year for the area burned.

3. The company guarantees nothing on account of the trouble that may be occasioned by fire in the course of *amenagement*.

4. In estimating the damage to reserved trees (*baliveaux*) the experts shall take into account:

a. The average age at which the trees are cut;

b. The age and total value at each age of all the trees damaged, as they would have been (had the fire not struck them) at the time appointed for their cutting;

c. The depreciated value, as above, that these trees will have at the said period.

The damage will be the difference between these two estimates.

5. In case of disagreement between the parties as to the amount of damages, a definite decision shall not be made until the month of September of the year next following that of the fire.

6. Following the methods of valuation above described for the coppice woods and *baliveaux*, the damage is to be calculated as it would be found when the wood had grown to the full period of working, at which time only in the ordinary course the insured could claim his loss. The indemnity that may be paid on account of the damage, if the woods burned have not come to their full growth, will be charged at the rate of 4 per cent. by the company, for so long as the object injured may remain until the regular time of working.

In determining the damages done to a forest by fire, it is to be remembered that the loss of wood actually burned may form but a small part of the injury sustained. It might justly include the expenses incurred in extinguishing it, the depreciation in value of what remained when cut for market, the damage to young timber not yet grown to a size fit for important uses, and, finally, the permanent injury to the soil itself from the burning out of organic material, upon which its fertility might in a great degree depend.

It is understood that insurance against forest fires has been undertaken in the United States to a very limited extent by individual underwriters, and upon their personal responsibility. The manner in which the transaction was done, in the one or two cases that have come to our notice, was not calculated to gain, and did not deserve, confidence. In one instance, where an insurance was made upon the timber of a tract of wild land, there was little or no knowledge of the risk incurred or the market value of the property insured. It was little beyond a random bet, but under the formalities of a contract and in apparent good faith.

Whether we regard the value of timber standing in forests as insurable or not, it is evident that this value, whether as a market price for present sale or as property held for future profit, is materially affected by the risk that is run of its being in any dry season either wholly de-

stroyed or greatly injured by fire. The uncertainty should at least lead the owner to incur any reasonable expense in the adoption of measures tending to avert the danger, or at least diminish the risk, either by affording facilities for checking the progress of the fires when started or by providing safeguards against their occurrence and the means for promptly suppressing them as soon as they are discovered.

VIII. INSECT RAVAGES.

1.—THE INJURIES DONE TO SPRUCE AND OTHER CONIFEROUS TIMBER BY INSECTS.

There is no kinds of trees without their insect enemies, that live upon them, or that pass some part of their lives in feeding upon them. The conifers are particularly liable to these injuries, and they are exposed to these damages at every stage of their growth, from the seed even before it has fallen or while in store, or from the moment of its planting, to the final decay of the timber, which is often caused and always hastened by their agency.

In the early part of this century extensive damages occurred to the pine timber of the Southern States from this cause, and at various times in regions where the pine and spruce timber is common these damages have been caused, and often to a great extent; but after a few years, through some condition of the weather unfavorable to the insects or from the increase of the animal life that feeds upon them, the balance of nature would gradually become restored, but generally accompanied by a succession of timber growth that was different from that which had been destroyed.

About the year 1875 the spruce timber in New Brunswick, along the Mivamichi River, began to die off in great abundance, the hills suffering more than the valleys, and the dense woods more than those where partial clearings had been made. The largest and best of the timber suffered most, and the younger growth appeared somewhat favored, but was not wholly exempt.

In the following year it appeared on the Allegash and other tributaries of the Saint John River in northern Maine. But few trees were affected the first year, but it increased very much for about three years, at the end of which time it was estimated that at least one-half of the marketable spruce was dead and unfit for manufacturing purposes.¹

These injuries extended through the spruce forests of the whole of Aroostook County and the most northern range of towns in Somerset and Piscataquis Counties adjoining. Further south the timber was less affected. The timber, if worked the next year, could be saved, but

¹ This estimate and opinion is given by Mr. Robert Connors, of Upper Saint Francis, who has been more largely concerned in lumbering operations in that region than any other person. In writing, in April, 1881, he expresses the belief that the injury had almost ceased, and says:

"I have been making diligent inquiries from parties that I have had out exploring in different localities (and have often been in the woods myself) and they all appear to think that the dying has almost if not altogether ceased."

Mr. Connors estimates the total loss of spruce in Northern Maine at not less than 1,000,000,000 feet, board measure, which, valued at the customary rate of \$1.50 per 1,000 feet for stumpage, would amount to \$1,500,000. He states that the whole of the black spruce region in New Brunswick is affected in a similar manner, excepting a narrow strip of about 20 miles wide along the shores of the Bay of Fundy.

It is stated by the *National Economist*, of Ottawa, Canada, that one operator in New Brunswick will cut 50,000,000 feet of spruce on the Nashwaak River the coming season (1881) because of the damage done by insects, and to save it from a total loss, which would be unavoidable if the timber were left standing another year.

somewhat impaired in value. It deteriorates, however, quite rapidly, and in the third year it is good for nothing.

On examining these trees the bark is found perforated with small holes, and in and under the bark (but not in the substance of the wood) there are found great numbers of the larvæ of a small beetle. The foliage of the trees attacked does not turn red, as when killed by a fire, but it falls off, a few stunted leaves near the tips of the branches being the last to remain. The bark of such trees has an unusually reddish appearance, but this is found to be due to the scaling off of the outer portion from the attack of woodpeckers, that come in flocks of unusual numbers to feed upon the larvæ.¹

Various theories have been suggested to account for this casualty. Some believe that the death of the timber results from its coming to full maturity, and that it is only a natural death from old age. Others, with more probability, regard it as primarily caused by a storm that occurred in November, 1871. There fell at that time an unusually great depth of snow, which being damp lodged upon the tree-tops, bending down the smaller trees almost to the ground, and breaking off others by their weight, which was increased by a rain. This was directly followed by a severe gale of wind, which began in the morning and continued with great violence through the day and night. It threw down much timber, and on some exposed ridges there was scarcely any left standing. These injuries extended hundreds of miles in Maine and New Brunswick. It is not improbable that this snow and the gale that followed it may have loosened the roots and in some degree may have impaired their vitality and thus may have rendered them more susceptible to the attacks of insects.

There are two species of the spruce in Northern Maine; the black spruce (*Picea nigra*) and the white spruce (*P. alba*), but these damages occurred chiefly along the former, perhaps partly because it grows in the lowlands and along the valleys of streams, where the trees generally appear to have more generally escaped.²

¹A lumberman who had worked in these forests where much of the spruce had died describes these birds as remarkably abundant. Their pecking upon the trees made a noise through the woods that was quite unusual, and in fact much beyond anything he had ever before heard, especially in the evening and with the first light of morning. There were two or three species, a few of the red-headed kind, but most of them of smaller size. They would even follow the trees to the grounds where they were yarded for survey and rafting, and pursue their occupation when not disturbed as the timber lay on the ground.

²The white spruce occurs on the upper waters of the Saint John, beginning at about the mouth of the Aroostook, and it extends further northward and into Canada, where it becomes an important timber tree. The black spruce, which is much more abundant, extends further south, where it forms dense forests, sometimes as many as a hundred large trees being found on an acre. It is from this latter species that by far the largest portion of the deals shipped from the province of New Brunswick (and partly grown upon the upper waters of the Saint John) is sawn.

The late Abbé Brunet, of Quebec, made a special study of the spruce in reference to its botanical characteristics and the geographical range of species within the limits of Canada, where both species occur in the greatest perfection. He employs the Generic name "*Picea*," as adopted by Carrière and some other systematic writers upon the conifers, and says:

"The *Picea alba* is one of the most widely distributed trees in Canada, extending from east to west and from north to south, and following the course of the Saguenay it is found along the river Mistassini to its source. At that latitude, however, its size diminishes, and it finally disappears entirely above the Cascades. It appears in the Hudson Bay territories, where, according to Richardson, it attains a large size and forms the most important forest tree in these northern regions. It is a tree of first dimensions, usually attaining in the most favored localities a height of 70 to 80

It is well known that there are several species of the *scolytidae*, the most destructive family of the coleoptera, that infest the spruce, especially when this timber has been felled from any cause; and where there is a great abundance of this fallen timber they multiply in prodigious numbers.

Upon a subsequent page we give the results that followed the prostration of many spruce trees by a storm in the region of the Jura, a few years since, and a statement of the energetic measures that were successfully employed upon that occasion to arrest the injuries that threatened to destroy what was left of the remaining timber still living.

In the case of the spruce found dead or dying in our northern forests, there cannot be the least doubt but that at the proper season an abundance of these insects in a perfect form may be found upon these trees, and their larvæ, in the form of small whitish grubs, in abundance in the bark, and between the bark and the wood, of every one of such trees, although there is a difference among naturalists of distinction as to whether they appear as the cause or the effect of these injuries with which they are so uniformly associated.

In such vast areas of woodland as we find in Northern Maine it is entirely hopeless to attempt the energetic measures that are employed in older countries for arresting these damages. We cannot expect that the owners of these lands can cause a careful inspection of each tree, and that they can cut down and peel for burning the bark of every tree found infected. The calamity appears beyond human control in a country where a well-organized forest service does not exist, and where there is such a wide disproportion between the value of lumber and the cost of labor as we find in our country.

feet, with a diameter of 25 inches at the base. It has been found along the Saguenay from 130 to 140 feet in height. The large trunks taper to the summit in the most regular manner; they are straight, and the branches extend out horizontally, and are arranged in true conical form, the top being slender and very symmetrical, giving the tree a very characteristic form. Where exposed to the winds the tree becomes scrubby and stunted, as on the island of Anticosti, where, in exposed situations, it scarcely grows 5 feet high, forming a kind of hedge from 10 to 20 feet thick and entirely impassable; but in the interior of the island it grows to its usual size. Its bark is whitish on the branches, but upon old trunks it presents a corky tissue of reddish brown and a scaly rhytidome cracked in all directions and peeling off in grayish white flakes, from which some authors think the specific name is derived. * * * This tree blossoms towards the end of May, in the latitude of Quebec, and ripens its fruit the same year, but does not shed its seeds till the next spring. The cones will then open with moderate heat." * * *

The *Picea nigra* is also abundantly disseminated in North America, and it may be said to be more extensively distributed in Canada than the preceding species, for we meet with it further north and upon the highest lands. The elder Michaux, in his manuscript journal, reports it as found upon the hills that border Swan Lake, but only of dwarfish size, and on the higher land it disappeared altogether, giving place to the *Pinus rupestris*, which reigns supreme in those boreal regions. The black spruce is a tree which, in certain localities, may reach a height of 70 feet and a diameter of 15 to 18 inches, but it is generally less and seems to dwindle in size towards the north. Around Quebec it does not grow more than 60 feet high, and on the Saguenay not over 40 to 50 feet, with a diameter of 8 to 10 inches. It delights in a humid soil that is black, deep, and thickly covered with moss. In soil that is constantly wet or much covered with water it scarcely grows, and never to much size. The bark of the black spruce is yellowish on the young branches, and the trunks of old trees have the bark corky and reddish, cracked more in the vertical direction, finally flaking off in scales that are somewhat square. * * * This tree blossoms in June, about eight days later than the white spruce, and ripens its seed the same year. * * * The two species of spruce show no difference in the structure, color, weight, and other qualities of their wood, which bears the same prices in the Quebec market. (*Histoire des Piccas qui se rencontrent dans les Limites du Canada*, par L'Abbé Ovide Brunet, Prof. Ordinaire à l'Université Laval, etc., Quebec, 1866, p. 16.)

With respect to injuries to spruce in Maine, it is thought to be progressively passing westward, and that it would gradually disappear.¹

A correspondent in Newport, N. H., reports that some forty years ago the mortality of the spruce timber was very great on the hills and mountains in that part of the State (Sullivan County), where the soil was shallow, and on the tops of ledges. It was then attributed to drought, but no exact observations were made.

In Sagadahoc County and elsewhere in Maine the spruce timber has within the last five years suffered greatly from the larvæ of quite another class of insects that feed upon the leaves of the season's growth upon every branch and twig. In the first year the injury was not great, but in the second and third years it destroyed the trees entirely. It is estimated that at least two-thirds of the growth of spruce is killed, especially near the sea-shore, where the timber is nearly all spruce. In districts where the growth is a mixture of different species the injury is less.²

While visiting the timber region of New Brunswick, in 1880, we made inquiries of the lumbermen concerning the time that the spruce required for restoration by natural growth, when the trees too small for lumber were allowed to grow. It was the opinion of some who had had the longest experience that where no trees are cut less than 11 inches at the stump a new growth would be made in five years sufficient to yield 2,000 feet, board measure, to the acre; but in this much depends upon the soil, and everything upon the protection that is given against fires.

The correspondent at Sherburne, Rutland County, Vermont (Hon. Daniel W. Taylor), reports the spruce as a valuable timber on the Green Mountains, and estimates from accounts received from lumbermen that fully one tree in eight in that town is either dead or dying, some beginning to perish from the top, and others from below upwards, and there being no noticeable difference between those that grow scattering and those in thick clumps on the ridges. He has not remarked any unusual dying off of the spruce in recent years, but says:

When a boy (I think 48 or 49 years ago next month³) the snow fell in the mud. The ground was not frozen, and the moist heavy snow lay 3 feet deep, hindering, as was supposed, the ground from freezing around the trees. The sap appeared to start, and when it came on cold, it froze, and started the bark from the wood, causing the trees to die. There was a very great number of spruce trees that died the next summer and the mountain tops looked red, so that the dead spruce could be easily distinguished from the live timber to a great distance. A great number of apple trees perished in orchards the same year, and apparently from the same cause. The bark would peel off part of the way around, sometimes six or eight inches in width, and generally on the south side.

A correspondent in Irasburgh, Vt.,⁴ writes:

The white spruce is abundant, fully equaling in quantity all other evergreens—hemlock, fir, and cedar. These evergreens are mingled with the deciduous trees, being

¹In the summer of 1880, in a journey through the extreme northern part of Maine, and in Canada further north, we visited a portion of the spruce forests and made a collection of the insects principally found in the bark. But the season of the year was not favorable for observing these insects, and but few could be found in a perfect form, although their larvæ were extremely abundant. Among the species identified by Dr. Geo. H. Horn, of Philadelphia, were the *Dendroctonus rufipennis* (Kirby); *Tomicus hudsonicus* (Le Conte); *Polygraphus rufipennis* (Kirby); *Xyloterus vittatus* (Kirby); an undetermined species of the *Xyleborus hypophloeus parallelus* (Welsh); *H. tenuis* (Lec.); *Cerylon castaneum* (Say); *Paromalus bistritus* (Er.), and a species of the *Halco-cerus* (?); of these the last five were neutral or not injurious.

²Letter of J. E. Mallett, Topsham, Me.

³Probably in 1831-32, which was distinguished in Northern New York on account of its deep snow falling upon unfrozen ground. A very general destruction of apple orchards occurred upon that occasion.

⁴J. E. Jamison.

more abundant in valleys and less upon the uplands. About thirty years ago a mountain side in Irasburgh was well set with spruce, and the foliage of standing trees turned red, the trees died, and gradually decayed and fell. The common report said that worms were the cause. This example was upon a tract of about 500 acres. The same land became occupied by maples, which have continued to flourish.

As mentioned in a former report,¹ the spruce timber in Northern New York has suffered greatly from these causes. A correspondent in Colton, Saint Lawrence County, in writing, April 2, 1881, says of a journey made in August previous:

After getting about forty miles up the river we began to come into a region where a large part of the spruce was dead, and at least half of it had lost its value. From such inquiries as could be made we learned that large portions of this timber were destroyed, including the best qualities and trees of the largest size. These injuries had been going on about ten years, and were still in progress. The yield of these timber lands was about 6,000 standard of 19-inch logs to the square mile.

Another correspondent in Saint Lawrence County, New York, reports that this dying of spruce timber had not been noticed until recent years, and that it was limited to the trees growing in wet ground.

In the Adirondack wilderness of Northern New York it is noticed that extensive tracts of dead spruce line the borders of lakes and rivers, where the casualty can be ascribed to a change of level in the waters from some obstruction in their outlet. In some cases these barriers are dams made for the purpose of floating logs in the spring, and it is well known that thousands of acres of timber have been killed in this region from this cause. It is not improbable that a tree accidentally falling across a stream, in a flat region, may thus cause an injury to standing timber without the agency of man.

A correspondent in Patrick County, Virginia, writes:

There is but a small amount of spruce in this county. In Pittsylvania and Henry Counties there was formerly a great abundance of the black spruce, but it is now mostly killed out by worms deposited in the bark by a large black bug. This dying off commenced about the year 1835. I noticed it in the chestnut first, then in the spruce, and then in the oak, all in the course of ten years. I had never heard of it until I observed it myself. I noticed that the chestnut timber was dying in certain sections first, and then it became general. In a short time it was so with the black spruce, and then more so with the oak. Upon examining a pine forest, I noticed a large black bug making holes in the bark and depositing its eggs. This was preceded by a gale, in August, breaking down some of the timber, and by chopping in the forest in that month. This dying off of timber has been growing less for the last five years, but it is still progressing rapidly in some sections yet. In Pittsylvania and Henry, and a portion of Franklin Counties, half or more of the valuable chestnut and spruce timber has been destroyed. It is not so much noticed in Patrick County, but is quite bad.²

2.—RAVAGES OF THE *BOSTRICHIUS*, IN THE FORESTS OF THE JURA, AND THE METHODS SUCCESSFULLY EMPLOYED IN ARRESTING THEM.

As an instance of the injuries from insect ravages and an illustration of the methods by which they have been arrested, we will cite from a special publication of the French Forest Administration in connection with the Universal Exposition at Paris, in 1878, upon the *Bostrichius* and its invasion in the Jura:³

The timber tree particularly suffering from this cause was the *Abies excelsa* (D. C.), or common European Spruce-fir and the species of insects that did the injury were the *Bostrichius typographicus* and the *B. chalcographicus*, of which the first attacked the

¹ *Forestry Report*, 1877, pp. 162-163.

² S. W. Tinsley (*M. D.*), Meadows of Dan, Va.

³ *Les Bostriches Leur Invasion dans le Jura*. Notice par M. Grandjean Conservateur des Forêts, 4^e, p. 24, 1878.

trunk and large branches, and the latter, which was seldom absent, found a lodgment in the smaller branches. Their habits were described as follows:

When the female of the *typographic* species is ready to deposit her eggs, which occurs about the middle or latter part of spring, sooner or later according to the temperature, she penetrates the bark, and bores almost invariably from below upwards, a gallery that is cut along the outer layer of the sap-wood, depositing her eggs as she advances, on the right side and the left. These are so quickly developed that the first larvæ will have themselves made considerable galleries before the parent has finished. Each of these larvæ digs a separate path of its own, more or less inclined to that made by the mother, and at the end of two or two and a half months they are transformed to a perfect insect, which in turn proceed to lay a new lot of eggs, and if favored by the heat of August these are sometimes found more destructive than the first. This second growth is matured towards the end of September, or beginning of October, and will be ready to resume operations in the following spring. In the mean time they pass the winter under the mosses and in the crevices of the bark, where they endure the severest frosts of winter, for the perfect insect is as hardy as its larvæ are tender.

The number of eggs deposited by one insect varies from 20 to 120 or 130, and from this bark we may make some very instructive estimates. Supposing that each laying of 60 eggs produces specimens in which the sexes are equal, one female will have produced 30 others, which would each before the end of the year be represented by 1,800 of their kind. Half of these, before the end of the second year, have produced 810,000 females, and by the end of the third year 729,000,000 of the producing sex, and the forest will have fed 1,506,600,000 of the progeny of this one parent.

The birds are not able to oppose more than a feeble resistance to the invasion, as the larvæ, protected by the live bark of the tree, and the insects hidden beneath the mosses or in the deepest crevices of the bark, defy the search of their enemies. They have, however, a foe that pursues them without mercy in the *Tillus formicarius*, a little coleopterous insect, about a centimeter in length, which runs with wonderful agility all over the wood, and wherever it finds the wood-boring destroyers it deposits its eggs. Its larvæ being longer, more slender, and reddish, are provided with six feet, and penetrating the galleries of the *Typographic Bostrichius*, they make effectual their work of destruction. Unfortunately these useful insects are not numerous enough to arrest an invasion of the *Bostrichius*, protected as it is by circumstances favorable to its increase. These circumstances are various. In the first place, mountain forests suffer from the attack more than those on the plains. A dry arid soil, a slow vegetation, and a forest with open spaces, are so many active causes in favoring the propagation of this insect. Nothing, however, is so entirely conducive to their increase as a great area of prostrate timber, whether from winds, or from cutting, especially when this felling occurs to vigorous trees in full sap, and when it is left on the ground with the bark still on. So decided a preference have these insects to these conditions that the idea has been suggested of employing them as a trap, and we may readily see how this might sometimes be done to advantage. Wherever in a spruce forest, we find a prostrate tree in the hot season with its bark still on, we may say with certainty that it is infested with the *Bostrichius typographicus*. We need not be frightened at its presence, for there are no spruce forests without it, but we should watch and check it if it threatens to become too numerous. To do this, it is sufficient to peel off the bark from the fallen timber, selecting for this operation as nearly as may be the time when it is most infested by the insect, and if we are careful to burn all the bark we destroy as well the larvæ, as the insects not yet quite completely formed and the females that have not yet laid their eggs.

But when this watchfulness is neglected their increase takes the form of an invasion, and they attack all the other trees favorable to their increase, but always showing a marked preference for vigorous newly fallen trees. From these they go to the standing spruces step by step, advancing steadily forward, and leaving a desert behind them, until at length everything is destroyed.

As already remarked, the tree is first attacked at the point where the great branches divide, or at least the first comers select that place, and after this, some settle above and some below, so that when we observe marks of the insect at the height of a man we may be certain that all the rest of the tree is perfectly full of them, and its death is not slow to follow.

In 1872 a cutting was visited on the 18th of June, and no indications of the *Bostrichius* was visible. On the 2d of July two spruce trees were dry, and their leaves red and falling at the least shock; the bark was loosening of its own accord in the upper part, but to a man's height there was still some life, but it could be easily peeled off, and showed within a surface burrowed in all directions and filled with larvæ.

Besides the rapid death of the spruces attacked, their wood loses much of its valuable qualities, being generally permeated with a bluish gray color; it is difficult to work, and soon rots.

The *Bostrichius typographicus* attacks only the spruce, but there is no insect that

makes such rapid progress in dense woods, destroying in a little time immense tracts of this timber. They have often had occasion to oppose its ravages in Germany, and an account of one of its invasions in the French Jura, will give an idea of its desolating power, the rapidity of its propagation, and the difficulties that attend our efforts at its extermination.

The *Bostrichius chalcographicus* seems to be in some way as it were under the protection of the *B. typographicus*. As soon as the first has manifested its presence the latter puts in its appearance. Living among the branches, it attracts less notice, and it may even exist in limited numbers without being noticed; but it is always found in company with the *B. typographicus*. In the Jura one is never found without the other. Its females, assembling to the number of from four to six, dig a common chamber into the bark, and being fecundated they dig from this point their galleries for laying their eggs, like those of the *topographic* species, in the living part of the bark and the outer layer of wood in lines radiating in all directions and forming star-shaped branches more or less regular in shape. As already observed, they locate themselves principally upon the branches, not sparing those of the smallest size; but they are also often found on the upper part of the trunk, in the intervening spaces left by the galleries of the *typographic* species. In the Jura, whether because they do not have time to descend, or in obedience to instinct, they are never found in the lower parts of the trees.

The rate of multiplication in animal life, says Buffon, is in the inverse ratio to their size, and the rapid increase of the *Bostrichius*, seems in general to confirm this law; but comparing one with another, the two species of this genus under notice seem to offer an exception to the rule announced by this eminent naturalist. The *B. typographicus* is two or three times larger than the *B. chalcographicus*, yet it appears to propagate with much greater rapidity. This circumstance, in connection with its diminutive size, appears to render its injuries much less to be feared; but we should remember that it appears only as the ally of its terrible relative. Together their ravages become a true calamity, that has devastated the forests of the uplands of the Jura for several years. We now purpose to give an account of the origin of these ravages.

The massive forest of Risoux occupies upon the third plateau of the Jura an area of 2,256 hectares 23 ares (about 5,575 acres) belonging to six different communes, and stocked with the spruce, silver fir, and beech, the first of these constituting about nine-tenths of the whole forest. The silver fir, although scattered through the other kinds, is chiefly met with in the southwest part, and the beech is found here and there in clumps that occupy certain places exclusively. The elevation scarcely descends below 1,200 meters, and rises to 1,386 meters above sea-level. The soil, moderately uneven in the southern part, is found much broken in the northeast and the general direction of the ridges is from northeast to southwest, following the general course of the Jura chain. The soil offered to vegetation is composed of a friable bed of calcareous material, drying very readily, and resting upon a rock that appears here and there as naked ridges several meters long and wide, and the depth of this soil is scarcely more than enough to receive the tracing roots of the spruce. In many places, they scarcely find a lodgment, except in deep crevices of the rock, known as *lésines*, which break up the rock formation of most of the Jurassic series. Upon the slopes that surround and limit this plateau are forests, owned by private parties, in which the beech predominates.

Looking from the Risoux towards the west, we observe two parallel chains, the summits and slopes of which are covered with forests owned by various communes, and mostly stocked with spruce, with some silver fir, and beech. These forests, known as the Forests of Grand Vaux, are in similar circumstances as those of Risoux. The slopes of the surface are much steeper in the eastern chain, called Joux-Devant, and Mont-Noir, and the altitude varies from 1,888 to 900 meters. The second chain, called Joux-Derrière and Combe-Noire, does not exceed 1,102 meters, its highest point. These forests have an area of 3,269 hectares 11 ares (about 8,078 acres), and comprise the forests of Bataillard, on the east flank of Joux-Devant, owned by the commune of Morbier, that does not form a part of Grand-Vaux, the name given to the undulating plateau between the two chains of Joux-Devant and Joux-Derrière.

On the 6th of November, 1864, a terrible storm struck these forests, passing from northeast to southwest. Its effects were terrible, according to the accounts given by the woodmen who were involuntary witnesses of the disaster. They hurried from the forests, where their lives were in peril, and the trees were bending almost to the ground, so terrible was the force of the wind; then recovering a little, they poised for a moment, and then under a new impulse, fell prostrate to the ground, tearing up with their roots the thin layer of vegetable soil that had supported them. On the next day the appearance of the forest was truly desolate. A long tract, with scarcely an interruption, and of variable widths, was entirely covered with overturned trees lying in inextricable confusion, and marking along the whole length of the Risoux the track of the gale. The number of trees thrown down was 88,718, of all sizes, with-

out counting the innumerable young trees broken and crushed by the fall of the larger ones. In short, nothing was left standing. In 1871, seven years afterwards, this tract presented the appearance of an immense waste, covered with the mingled debris of fragments and stumps.

[Here follows a table showing the details of disaster in six forests named, having an area of 2,256 h. 23, in which 83,718 trees, of 53,010 cubic metres contents, had been overthrown.]

In the Grand-Vaux the tempest raged with equal force, but less regularity, and chiefly on the chain of Mount-Noir and Soux-Devants. The injury extended to still other points of the Jura, but with less severity, and spent its force as it receded from the center of greatest violence.

This disaster was only the forerunner of another, of which we will particularly speak. Most of the overthrown trees brought up the soil that covered the roots, and it was evident that these trees would still continue to have some life, and that the next spring they would offer to the *Bostrichius* a marvelous opportunity for increase, and thus form, as it were, a focus of infection that would endanger permanently all the trees around them that remained standing. Many of the latter had been loosened, had lost some of their roots, and were in part torn down. It was evident that many would not long survive, and that shortly they would be in condition to favor the multiplication of insects. It became a matter of urgent necessity to take away the prostrate timber as soon as it could be done; but it is no easy matter to remove so vast a quantity of trees in a short space of time, and everything tended to render the operation long and tedious. Notwithstanding the immensity of the task, had the forests belonged to the state it would have been an easy matter to have obtained an order for putting the task in hand for immediate execution; but it became necessary to sell some in lots, taking the whole clean off; in others to sell by cubic contents, a lot at a time as it could be worked and got out of the confused mass, and in such a way as to avoid dangers. Here, again, the timber belonged to six different communes, who had to consult and deliberate, and before doing anything they must know the value of the products. They decided that a part should be sold for the benefit of the communal treasury, and the remainder divided among the inhabitants.

The forest administration sent agents to allot and appraise the wood, a task by no means easy to accomplish, and besides all of this, winter came on with all its rigors, and the deep snows that always abound in these elevated regions considerably delayed these labors. Everything was finally ready for sale on the last day of July, 1865, but it was already too late. It was found that the *Bostrichius* had completed their first brood without hindrance, and that those of the second had mostly escaped destruction. As for the wood given to the inhabitants, the affair was even worse, and in 1866 they were still discussing questions relating to delivery. They would not believe the danger that the forest agents pointed out, and insisted upon the value of the bark. Some of the communes, after having voted for the delivery of the wood, recoiled before the difficulties of working, and some of the timber thrown down in 1864 was still lying on the ground in 1871.

During all this time the *Bostrichius* had a marvelously favorable opportunity to increase. In 1867 and 1868 the agents of the forest service observed numerous trees dead, either from the effects of the storm or the attack of insects.

In 1869 it was no longer possible to mistake the dangers of the situation; the *Typographic bostrichius* was master of the forests of Risonx and of Grand-Vaux, and the foresters raised a cry of alarm, which the communes either did not understand or did not wish to believe. The knowing ones, as they esteemed themselves, men of genius in their way, and the strong-headed, each argued in their own style on the causes that led to the dying off of the woods. Opinions the most absurd were expressed, and each supported by some theory; yet every one appeared unwilling to accept the truth. About this time the *Phylloxera* began to create a great alarm in Southern France, and there were some who insisted that a spruce *Phylloxera* was devouring the roots, and advised that the cattle should be made to urinate around the trees to exterminate this destroying insect. All of these theories found their partisans, to which they adhered instead of accepting the plain and simple one assigned by the forest agents. Nobody would admit the presence of the *Bostrichius typographicus*, and they denied this still in 1870, when already more than a hundred thousand trees had perished from its ravages.

The woodlands owned by private persons and those parts of the communal forests where the beech predominated almost completely escaped this invasion.

But the situation became urgent for a remedy, for not only were the trees dying, but their wood had no longer the qualities that render the spruce so valuable when grown on elevated plateaux. The timber of Risonx, so valued for its elasticity, its strength, its durability, its fine and brilliant grain, and the facility with which it could be worked, could now scarcely find sale in the market of Lons-le-Saunier. It was rejected on account of its dead bluish-gray color and the easy and premature decay that were now observed in it. It choked in the plane, and the cabinet-makers would have nothing more to do with this plague of a wood from Risonx.

The prefect administration joined its efforts with those of the forest agents, and, thanks to its exertions, the communes at length granted the credits necessary for opposing the invasion. The general forest administration delegated to a conservator the power to authorize the working of the woods attainted by the *Bostrichius*, and sent its auxiliary agents to the aid of the local agents, who alone would be quite unequal to the undertaking, however well disposed. They were even able to authorize, in a general way, the cutting down of infected trees, save that they were required to render an account as the work progressed from time to time; as, for example, at the end of every week. There was, in fact, no danger of abuse, for every tree attacked showed upon its inner bark the perfectly apparent galleries, and the simplest supervision might distinguish a healthy from a diseased tree.

They put themselves immediately at work, but on the first step a new difficulty was encountered. The work of examination consisted in the inspection of every tree, so as to determine whether it was or was not attacked by the insects. To this end the guards formed with the wood-cutters into little parties of five or six men, went through the forest from tree to tree in narrow tracts, under the direction of an agent, who examined the trees pointed out, one after another, and struck with the marking-hammer the trees that were to be cut. This was a duty that required intelligence, good intention, and assiduity on the part of the workmen. The rapidity with which the insect laid its eggs and went through its different phases of life would admit of no delays in this operation. But the workmen of the country manifested little zeal in responding to the appeals of the forest agents, and the greater part of those who consented to hire their services took everything easy, so that it was impossible to obtain of them a faithful and regular service. The sad events of 1870 brought grief to the inhabitants of the district and increased the difficulties against which the agents were struggling. This led them to seek assistance from abroad, and to organize some parties of Piedmontese workmen, well-esteemed among the wood-merchants and employed by them in preference to those of their own localities. From this time the pursuit became regular and efficient.

This examination of the wood attacked forms the most delicate, the most difficult, and the most thankless part of the operation. But if the men are intelligent and attentive they may be trained by a few lessons from the forest agent to a very good idea of the course and habits of the *Bostrichius*. The directing agent should especially guard against allowing himself to appear wearied or indifferent. The necessity of the occasion is not less urgent than it is monotonous to fatigue. He must, nevertheless, keep a keen watch of the men, and excite and sustain their attention by every device he can think of; but if he allows himself to appear indifferent, half the infected spruce trees will escape his search.

As the tree is first attacked in the place where the first large branches come out, and descends little by little, it is at first very difficult to recognize the presence of the insect. Their entrance holes are not visible at this height, and when seen by the eye at some distance it often happens that the larvæ have already passed into the perfect insect in the upper part. Their presence is disclosed by the thin foliage of a dull tint, a dark-gray bark, the fall of leaves upon the least shock, the exudation of gum from the worm-holes, but principally, and with most certainty, by the worm-dust of reddish brown that has been stopped in its fall by the roughness of the bark, and by the mosses, more or less abundantly, below the point of attack. In a dry time we may often see around the foot of the tree and between the roots some spider's webs that have caught this dust, and passing the hand under, it becomes perfectly visible.

When a tree was suspected to be tainted, but the fact could not be shown without the most minute examination, the Jura guards used a strong hook, fixed to a handle 3, 4, and even 6 meters long, by means of which they could take off a piece of bark at a considerable height, and expose the galleries that would escape the common means of observation. But this method should be used with caution, as it has the inconvenience of wounding the trees that might not prove to be affected and that should be allowed to remain.

The examination of a tree should be commenced on the south side, because the insect almost always begins its injury upon that side. Besides this, the solar heat is more favorable for their development, and it is quite natural that it should work more on that side than on the north, where the sun's rays never strike.

The wood-cutters, as soon as the fact is determined, proceeded to cut down the trees marked for cutting, trimming off the branches and, immediately after, the bark, all of which, with the branches, are given to the flames. The latter, under the circumstances, having no value, their peeling and reservation would have entailed a complete loss and a great expense of money and of time.

The object of the burning of the bark was to destroy the female insects that had not yet finished laying their eggs, and which had settled upon the tree for this purpose. Usually, when disturbed in their operation by the shocks given by the ax and in the peeling of the bark, they would crouch into the end of their galleries, hiding their heads as much as possible in the inner layer of the bark, and being found in this

position, they perished in the flames. A few would fall into the mosses and escape, but there were not many thus lost, the greater portion being burned. The same fate happened to the young that, having come to a perfect form, would remain some days in their galleries. It is important that the fire be brisk, so as to catch the insects, which as soon as they felt the heat would endeavor to escape by flight. They therefore first made the fire of brush, and got the flame very active before throwing on the bark, so that in this manner the *B. chalcographicus* that inhabit the top branches perished with the *B. typographicus*.

It has been recommended to spread cloths under the trees after felling them, so as to catch the females that might fall to the ground during the peeling of the bark. This would be all very well if we had but a few trees to peel; but when we find ourselves in the presence of a veritable invasion it becomes quite out of the question. To convince ourselves of this it will suffice to consider the condition of the woods worked in the forests of the Upper Jura, given further on in this article.

As for the larvæ, it is not necessary that they should be destroyed by fire. As they can live only in the bark, they soon perish when the bark is taken off. They cannot endure exposure to the sun, but they do not always die so soon as is generally believed, for some exposed at four o'clock in the afternoon were still alive at night, and some the next morning; but it is not the less certain that barking of a tree insures their death.

It is not absolutely necessary to proceed at once to the peeling of a tree as soon as it is cut down. We have already noticed that such trees are great favorites with the Bostrichius, and their presence for a while may be the saving of a goodly number that remain standing and that have hitherto escaped their attacks. In 1872 we were obliged to cut a certain number of spruces in order to make way for the removal of a cutting located in the forests of Grand-Vaux. They were immediately attacked by these Bostrichius, and orders were given not to peel the bark, but to closely watch the development of the insects. These followed the same law of attack upon the prostrate timber as upon the standing trees, settling themselves first in the region of the large branches, but extending very rapidly over the whole trunk. Towards the end of July these spruces were saturated with larvæ in every part, and the perfect insects began to make their appearance. The branches were then cut off and the bark was peeled, and the whole burnt. The canton in which these spruce trees grew had been severely attacked the year before, but was by this means almost entirely preserved. These fallen trees, placed at the disposal of the insects, are therefore an excellent trap, and when the invasion is not very severe, and when we are able with certainty to watch their development, this means of destruction may be employed with advantage. But when we find ourselves in the midst of an invasion as formidable as that which appeared in the Jura it would be rash to leave these refinements of method upon so great a scale, for the incessant search for trees attacked will abundantly employ the whole force and the attention of those directing it. They would run the risk of coming short of their duty while perfecting their methods, and it would be much better in such a case to cut down, to peel, and to burn while the presence of the insects was evident.

The burning of bark is always a delicate operation, on account of the danger of fire escaping beyond control, and in the Jura it required particular watchfulness. The crevices, or *lésines*, were filled to a great depth with vegetable *débris*, the whole often hidden under a covering of moss. It often happened that the fires concealed in these crevices would brighten up some days afterwards and spread into adjoining portions of the remaining woods. In 1872 the forest agents visited at 10 o'clock in the morning a working that had been left eight days before, and there was no smoke indicating the presence of fire. At 1 o'clock in the afternoon it started up with such vigor that it attacked and partially burned several sticks of the peeled timber still left upon the ground. It is therefore indispensable that in similar cases we should visit the places where fires have been made for a long time after they have been abandoned.

A single search through the forest will not suffice; and as soon as it has been gone over we should immediately begin again, taking by preference the points most exposed. As a general rule we should make at least two of these thorough examinations; one designed to seek the brood of the spring season, and the other about the last of August or first of September, when the larvæ of the second brood are in full activity. As it is unavoidable that, from one cause or another, we must pass by some of the trees that are attacked, we should for this reason repeat each of these searches, so that the forest shall be examined four times, and, if possible, still more times, during the season.

The employment of these means in the forests of the Jura resulted in success at nearly every point, notwithstanding the obstacles encountered by events and the indifference of the local workmen, and of this fact the campaign of 1871 gave proof. The woods infected had diminished 65 per cent. in number and 46 per cent. in cubic contents of the timber cut. Notwithstanding this, at certain points the damage was more considerable than in 1870, and the invasion appeared in districts of the forest

where it had not been before observed. The labors of the previous year were renewed, and the same difficulties were encountered on the part of the men employed, and from some communes. The latter failed to provide the funds until some time had passed, and the former were delayed until a part of the insects had done their damage and issued from their galleries in a perfect form; but in face of all these difficulties there was still a slight diminution in the general result, as was proved in the campaign of 1872.

But it was necessary to cut short these ravages, which, although diminishing every year, threatened to hang over us forever. In 1872 the work was organized upon a different plan. As regards the search, it was made from day to day as formerly, but the wood-cutters not otherwise engaged were occupied in cutting down the trees as the search progressed, and each chief of a party, at the end of the week, sent in a statement of the trees he had given up for working. The same difficulties appeared again, and the same commune which the year before had shown an aversion to the business refused the necessary credit, so that it became necessary to have recourse to a decree from the President of the Republic, which was obtained just as the municipal council, yielding to the pressing solicitations of the prefecture, had decided to accede to the propositions of the forest service. From this moment the agents, freed from every hindrance, went boldly forward with a vigor that promised to make them soon masters of the invasion.

During this same year, 1872, the *Bostrichius* appeared in some forests where it had not previously been seen, and quite distant from the focus of the first invasion. The alarm was taken, and they hastened to work all the trees that bore signs of perishing; but when the subject was verified it became known that besides the fallen timber, which was quite considerable, but a single standing tree was infected, and even this was half dead before the insects had attacked it. Yet this feeling of alarm that the forest agents felt was entirely natural, as the examples of Risoux and Grand-Vaux had inspired every one with ideas of danger.

This campaign of 1872 was decisive. If the invasion had been diminished before, it was now arrested completely. In 1873 the credits placed at the disposal of the forest service were scarcely used, and in several forest they proved completely needless. Most of the trees worked in this year were fallen, to which were added by way of precaution, some others that were dying. From this period we have met, as we always do, some of the *Bostrichius* in the fallen timber; but it is seldom met with in standing trees, even when perishing.

In 1872 the Risoux, which had suffered severely from the invasion, yielded but 32 fallen trees that were found infected, and, as a remarkable thing, some others that were not, while not a standing tree of any description showed any signs of the insect. In the Grand-Vaux and at Bataillard the presence of the insect was found in eleven fallen trees only, and in two decaying trees still standing. Every year the communes, now enlightened as to their true interests, have placed a moderate credit at the service of the forest agents, to be ready in case of first need, should the insect appear in threatening numbers, and this fund is either spent in peeling the few trees that fall or is often left unexpended.

The foregoing account presents the material measures to be employed in opposing an invasion of the *Brostrichius typographicus*. There are other measures of a purely administrative nature that it is important to examine.

It is useless to leave the task of struggling against this evil to the chief of a cantonment, who, with the responsibilities of his ordinary duties, would not be able to take on the additional labors that it involves, and one of these objects must suffer, to the detriment of the forests and of the interests depending upon them. The foregoing statements sufficiently point out the fact that the agent charged with the duties of opposing these insect ravages must give the subject his whole attention and every moment of his time. It is therefore essential that there should be provided an auxiliary *personnel*, composed of foresters of the most observant class, the most devoted, the most persistent, and well enough acquainted with experimental investigations to solve the many secondary questions that will arise in the forests submitted to his care, especially those that pertain to the administration of the communes, and which are so liable to complicate an operation, however simple it may be in itself.

Persons employed for a whole season in passing through a forest from dawn till sunset, counting, measuring, and examining trees, will find themselves engaged in a fatiguing and monotonous but delicate business, and it will need a great force of will in preventing it from appearing in the eyes of subordinates that they are weary with the *ennui* that attends such employment. Persistence is a quality of the first importance, and should be the first thing required of them.

The chiefs, who direct the operation from a distance, ought to examine with care the reports furnished statutely at short intervals. If in respect to a great number of trees examined the accounts are too brief and insignificant, he ought not to hesitate to go himself upon the ground, to reanimate their courage by his presence, suppress

any hesitation that may appear, and inspire that confidence that secures the greater effect than the best devised and most detailed of instructions, or the most urgent of exhortations sent by mail. He will have still greater influence over the subaltern *personnel*, of whom there are few that do not feel the influence of a chief officer high in the ranks of the administration who leaves his station and comes from afar to share the labors of the humblest subordinate.

The manner of selling the products of these cuttings is very important. If sold standing, the cost of cutting to be borne by the purchaser, in addition to all the formalities which the forest regulations prescribe in such cases, there may arise considerable delays, often sufficient for the *Bostrichius* to take their flight, and the operations prescribed will not be done with the rapidity that circumstances require. Whatever be the vigilance of the forest agents and their assistants, they will always fall short of the end proposed; and our experience in the Jura leaves no room for doubt upon this point. The funds granted by the tribunals will always be small as compared with the damages occasioned by a tardy working, and this fact is sufficiently proved in the preceding statements.

We have thus far supposed that the direction of a working should be left to the care of the owners of the forest, and we may obtain this result in two ways: The first, and apparently the simpler method, consists in the sale of the wood after it is cut and peeled; but as several considerations arise upon this point, we may be obliged to wait till the end of the year before completing the arrangements or run the risk of falling into new difficulties as to the wood lying upon the ground, side by side, and often interlocked with other trees of other cuttings, and sometimes belonging to different purchasers. There is another mode that appears to succeed best, although it would at first appear to be attended with inconveniences, especially in actual practice. This is the sale of the timber standing, with all the products, leaving the working to the care of the proprietors. This sale may take place before the search for insects, and the contractor takes the delivery as the examination progresses. By this means the lands are cleared off of the wood condemned for cutting as fast as the work goes on, and the wood when taken off still has its full value.

The first step to be taken is to make sure of the money for paying the workmen punctually. A private persons may always make sure upon this point at once; and as for the state forests there is but little difficulty, and for the credits that an agent may need the means can always be provided in seasonable time. But in the communal forests the case is altogether different; for, besides consulting the municipal authorities, who are seldom in haste, we are more frequently met by unforeseen difficulties from the perverseness of those wrongly disposed, as we have seen happen in the Jura, notwithstanding the urgent intercession of the prefecture. In these cases the sums asked were only granted with reluctance, and when obtained they came too late to be useful in the operations. The forest agent who suspects the presence of the *Bostrichius* in the forests under his charge, in such abundance as to require measures for its suppression, ought to begin the winter beforehand to secure the credits needed for his use, so as to be able to begin his campaign as soon as the working of the insect has begun.

One calamity brings on another. We have seen how the timber prostrated by a storm has brought on an invasion of the *Bostrichius typographicus* and *B. chalcographicus*. The great number of stumps of the trees left from such a calamity favor the multiplication of the striped *Bostrichius*, which willingly find lodgment, and are soon found everywhere, but most in the stumps of trees freshly cut, in the wood overturned with the bark left on, especially if felled before the sap, and in unhealthy trees still standing, or more rarely in healthy trees, but this never except in cases of excessive abundance, and never in trunks cut in the sap season and at once peeled. This striped *Bostrichius* does not actually kill the trees, as does the *Typographic* species, but it bores the wood with a multitude of little holes, rendering it improper for any other use but fire-wood. The female pierces the bark and the wood by boring perpendicularly to the axis of the tree to a depth of several centimeters, and digs galleries horizontally, right and left, generally in the layer where they begin and in the same spring-growth wood, and in these it deposits its eggs alternately on one side and the other, in the same manner as the two species already described. The galleries of the larvæ, being thus in the same woody layer, are vertical, and very much resemble the black matting characteristics of the kind of cryptogram growth known under the name of *Moisissures*.

In 1872 these insects became so abundant in certain forests of Grand-Vaux that they attacked standing trees and injured a great number of the most vigorous. The first remedy to be employed is the extraction of the stumps, but this imposes a task both tedious and expensive; and then what is the product worth when you get it? We should urge the wood-merchant to draw the wood of their trees away from the forest before the middle of August, the period when the insect comes to a perfect form. The punctures made in the standing trees predisposes them, by weakening the vege-

tation, to the attack of the *Typographie bostrichius*, and they should be cut down, peeled, and drawn out of the forest as soon as may be, as well to keep them from the latter insect as from the striped kind.¹

Some further details concerning the *Bostrichius typographus* are given in a little manual prepared by MM. De la Blanchère and Robert:²

This insect, found exclusively upon the spruce, is doubtless named from the peculiar form of the galleries that it makes, which, when the bark is peeled off, show traces both on the liber and on the wood; something light; printed characters. From the special form of each gallery we may always recognize the kind of xylophagous insect that has made it. Every one of these little creatures mines always in the same manner and form.

The *Bostrichius* is quite plump, of a dark brown, but at first sight they appear black, and they are provided with an inflated carapace. They are from 3 to 5 millimetres in length. The *Typographie* species makes its appearance about the month of May, and at once begins to prepare a nest for its larvæ, which are whitish, with a brown head and six legs. The insect is somewhat particular as to the place where its young shall be placed. Like the *Hylesine*, it prefers a tree recently fallen, but still containing its juices, or, if this is not found, the top stick in a wood-pile, and is so satisfied with such wood, when in the condition best suited to its wants, that when a tree has fallen in the forest it will abandon all the neighboring standing trees upon which it has already begun to work, and in a few hours the newly-fallen tree will be literally honeycombed under the bark by these insects.

When the *Bostrichius* has found a tree suited to its wants, it begins with its mandibles to dig a little round hole into the bark, slightly inclining upwards. If the weather is warm the little miner finishes its task in a day, or sometimes in less time if the bark is thin; but if it is cold, as often happens in the month of May, it has less strength and energy, and it sometimes takes a week to penetrate through. In a standing tree it prefers a place somewhat high up, and about where the first great branches come out.

When the bark is once pierced, the *Bostrichius* digs along under the inner surface a little chamber, where the sexes meet, and which serves as a point of reunion not only of one, but sometimes of three, four, or five couples; and then from this common apartment they dig separate galleries from below upwards, in this its habits being the reverse of those of the *Hylesine*, which descends from above downwards. The number of these separate burrows depends on the number of couples of insects. But the little architect is not satisfied with constructing any permanent abiding-place whatever. It requires the air, perhaps the light; and what does it do? It provides in each of its galleries from two to five holes, which pierce the bark through its principal substance, but leaves an extremely thin pellicle of the external epidermis, which thus performs the office of a window, but one that is as pervious to the air as the lightest tissue of silk. The female then lays sixty to eighty eggs, which are minute, translucent, and whitish, and places each one of these in a little notch, covering them with the worm-dust formed from the wood that has been eaten, and then dies.

In ten days the little larvæ appear and immediately begin their work, always digging galleries in the liber and the inner bark, where they find at once food and shelter. These secondary galleries always leave their trace on the sap-wood when the bark is peeled off. Their size increases with the growth of the insect that lives in them, and when this tenant has come to its full size it digs out a little chamber, where it goes through its metamorphosis. To give time for its integuments to solidify it opens irregular galleries, that destroy the symmetry of the first work, which was entirely done by the mother insect.

¹This article is followed by statistical tables showing the result of operations by forests and by years. It may be sufficient to here quote the general result in the three forests, having together an area of about 8,707 hectares:

| Years. | Recapitulation by years. | | Forests. | Recapitulation by forests. | |
|-------------|--------------------------|-----------------------|---------------------|----------------------------|-----------------------|
| | Number of trees cut. | Volume, cubic meters. | | Number of trees cut. | Volume, cubic meters. |
| 1870 | 105,657 | 35,226 | Risoux | 137,614 | 41,764 |
| 1871 | 38,599 | 18,841 | Grand-Vaux | 39,678 | 28,067 |
| 1872 | 34,146 | 17,646 | Sundry others | 4,286 | 3,077 |
| 1873 | 3,176 | 1,195 | | | |
| Total | 181,578 | 72,908 | Total | 181,578 | 72,908 |

²*Les Ravageurs des Forêts et des Arbres d'Alignement*, Paris, 1876, p. 119.

In short, it is wonderful to see how much of all this great work can be done by a single generation of these Typographs, and all in the course of ten or twelve weeks. The newly-formed brood does not delay its task of reproduction, and this second generation, probably on account of the warm summer nights, does not require more than eight weeks to come to full maturity; but this last brood must wait till the next spring before laying, and it passes the winter under the mosses and hidden as best it can be in the crevices of the bark. If the weather is unfavorable, the first brood may require sixteen weeks to mature, and there is but one generation in a year. This is a lucky circumstance that frequently happens, for we have ascertained that in great invasions a single tree may contain more than twenty-three thousand pairs of these insects. How many, then, would there be in a forest? From what has been said it will be evident that we could not figure upon the numbers of these little black miners, and could we do so, it would fall short of the reality.

The expense demanded in fighting against these insects is enormous; for, in order to assure ourselves that we have conquered, not a single perishing tree should be left in a forest, and this is a condition seldom seen. In short, the Typograph is an insatiable enemy, against which all palliative measures will prove ineffectual, and no measures but those the most energetic and extreme will succeed.

In the treatment of an insect like the *Bostrichius* our remedies must be preventive rather than with a view of immediate relief from the evil when it is upon us. These precautionary measures are to be found only in a forest culture that is very watchful and where the species of timber growth is perfectly well adapted to the climate.

When, on the contrary, an invasion has come, we must cut down the evil to the root, and the peeling of the bark from the trees infected is our sole remedy; but this measure necessitates the felling of entire cantons in the sap-season; but this also increases largely the expenses of working; but this also greatly diminishes the value of the wood; but when the evil is incurable we must give up the contest or work when we can!

The peeling should be done before the transformations of the second brood are finished, and therefore in the month of August, or at latest September; but in this nothing can with certainty be fixed beforehand, and the forester must be governed by the progress of the plague, and must apply his remedy as he finds the insects in proper condition to destroy. He should be too early rather than too late, because the operations of felling and peeling cannot be done at once, and so long as the trees are standing or prostrate the process of destruction is going on if the bark is still on. After the insect has once come to maturity nothing is harder to kill, since they will survive a floating the most protracted, and if the logs are floated with the bark on the task is left half done and all the expense is lost. The operation of peeling is, therefore, a remedy that cannot be lightly applied; and, however carefully we may proceed, it still affords some chances of uncertainty.

All the *Bostriches* in the condition of larvæ or of chrysalis will perish when exposed to the sun and the rains after the bark is taken off. Here we find one consolation, in this—that somebody has offered a theory that the spruce cut in the sap-season is of better quality than when vegetation is at rest! Let the future clear up this point.

Along with the Typographic species we always find its faithful but diminutive friend, scarcely 2 millimetres long, the *Bostrichius chalcographicus*. This little xylophage is also very destructive, but it does not work in the same manner. It radiates its galleries from a common chamber, instead of ascending, and along the five or six principal galleries the female deposits her eggs. The larvæ of this species soften penetrate into the sap-wood.

In combatting one of these terrible ravagers we also destroy the other, for it prefers the trees already fatally attacked by the larger kind. Nothing is more difficult than to fix the exact time when the invasion begins, and this for two reasons. The first of these is that all the entrance holes are found quite high up on the tree, and are so small that they cannot be seen without difficulty; the other reason is that the trees will still vegetate for some time after their mortal enemies are in their sides. In proportion as the damage progresses the marks of the workings of these insects become more easy to observe, and the spider-webs often found at the roots of trees, the mosses, and the bark itself will be found dusted with a fine powder of the bark, and the leaves will begin to fall. As the foliage of the spruce is naturally quite dense, this diminution of shade is very readily noticed but alas! it is already too late; let a strong west wind strike the tops of the great forests at such a time, and the winged insects will be borne to great distances, to ravage other regions where they were not found before. This fact is perfectly well verified, and although it may seem remarkable at first, it will appear all the more easily explained, since the forests attacked by this insect are always upon high mountains, and often upon dry positions, fully exposed to the sun. When the winds strike such places they take clouds of these insects, as they do of the locusts, and bear them off to the highest trees in the valleys. Against all these ravagers of the forests we may employ tree-traps, that is to say, trees already perishing, which are left till overrun by the insects, and then, watching the favorable moment, destroying them in their retreat. To render this method effect-

nal the traps should be quite numerous, and the attendance as closely watched as a garden; a thing we can scarcely expect in a forest. "It is useless;" "it is impossible." This is the conclusion we arrive at in all these palliative researches. The greatest efforts of man become powerless when he tries to attack and control the vital forces of nature.

3.—INSECT INJURIES TO HICKORY TIMBER.

We have in a former report¹ alluded to the destruction caused to hickory timber by the *Scolytus tetraspinosus*, a minute beetle that bores into the wood, and continues its ravages until it is ruined.

This beetle is said to never attack the heart-wood, and rarely the wood taken from more than two inches below the bark.

The timber intended for carriage-spokes, if cut at a season when the sap is not flowing, and then thoroughly and properly dried, is less liable to injury than in cases where these precautions are not observed. August is the best month for cutting, as the wood then has less sap in it than in the earlier months.

Much of the trouble in carriage-shops results from the breeding of this insect in places of storage, and a place once infected may keep up the source of injury from year to year if rubbish is left neglected, and especially if worm-eaten wood is left around. It would be better to establish entirely new and clean places of storage, which would at least afford immunity for a time.

Mr. Howard M. Du Bois, in an article in "The Hub" upon the damages done to second-growth hickory by the powder-post insect, after describing the insect and its habits, offers the following suggestions by way of remedy:

Many years ago it was observed that hickory cut in the months when the sap had exhausted its vitalizing qualities upon the leaves and fruit, and when the fresh ring of new wood was solidifying, seemed to be free from the attack of these worms, even after an exposure of two or three years. This was at first regarded as an old-womanish idea, as experienced woodsmen insisted, and still insist, upon attributing this exemption of the timber to the influence of the moon in certain months, being so particular in some instances to designate the "old of the moon."² Freeing these assertions from all superstition, we find by experiment that there is a time for cutting that presents less inducement for depositing the eggs of these pests. Here we would call attention to the important fact that these insects *never* enter the duramen, or heart-wood, and as the hickory often shows no change of color between the alburnum, or sap-wood, and duramen, this may account for their not penetrating very far into some kinds of timber, while that composed of sap entirely is powdered and destroyed.

It will be noticed that timber cut when the timber is most dense and free from the watery sap of the leafing months will have time to partly season before the reappearance of the beetles, which, as before stated, occurs (in the climate of Philadelphia) in May and June. For experiment we prepared specimens of timber cut when vegetation had ceased, one being marked July 26, one was cut 18th of August, while another was prepared in the first week of September. During the following May powder-post beetles were placed upon these specimens, and they were constantly exposed where these insects were crawling, but they remained free from worms, even after three years' exposure, while specimens prepared from timber cut when the sap was running were entered at once. The piece marked 2 was cut in March, while another badly-peppered specimen was cut in April; some specimens cut in November were badly punctured, while those cut in January and February were only slightly affected.

It being an impossibility, from the great demand for hickory, to fell or procure it within the limits of the short season mentioned, our thoughts must be turned towards seeking for preventive measures, and these we will discuss further on.

The experiments mentioned above were made, as carefully as possible, by one whose active duties did not admit of the time and care that should be devoted to the subject by a purely scientific experimenter; but we think they will show the value that would attach to a series of experiments carried out under scientific supervision.

We have said that these insects are secure from destruction by birds or other extraneous checks to their development, and their rapid increase has certainly proved this; but in some of the specimens of timber we were experimenting upon we noticed that,

¹ *Forestry Report*, 1877, p. 162.

² December, 1879.

although the larvæ got a fine start, they, at the end of the season, failed to produce the customary crop of beetles. This led to investigation as to the cause, when we were pleased to find that an enemy to their development existed, in the shape of an *ichneumon*, or fly, which deposits its eggs in the living larvæ of the *Lyctus*, which egg in time develops and devours the larva before it changes to the beetle form. * * * Although we feel that we cannot hope for material relief from this quarter, still we should welcome the *ichneumons* as recruits, and hope their numbers may increase.

While trying the experiments with the specimens of timber mentioned, we tried some where the temperature of the place was kept regularly between 95° and 100° Fahr. These pieces were never visited by the insects, though they were placed where they could easily be reached. After exposure in this manner for two seasons, the specimens were placed in an ordinary temperature, when the following season the beetles infested them, destroying one entirely, while the others were badly damaged.

We will now proceed to consider the question of prevention. Let us see what facts we already have as a basis.

First. It is conclusively shown that this "powder-post" is the work of an insect which appears periodically; and that, at least in this part of the country, these periods occur yearly, covering the months of May and June.

Second. We have also shown by experiment that no germ or egg will live if subjected to a temperature of 212° Fahr. Some reader may here say, "But carriage-rims become wormy even after being steamed, and that, too, when no beetles are about to infest them." We know this is a fact, and we account for it in the following manner: We stated that the female laid the eggs in the dust at the extremity of the old passage; now, this dust may become scattered on floors, &c., by handling the material, and these germs floating about may be taken up by the timber upon which they settle, and thus become vitalized. Of course, this is a mere conjecture; but we have noticed that hickory never becomes wormy within the season mentioned unless piled in places which have been used previously for the same purpose, or where this worm-dust has been scattered.

Turpentine has been suggested as a preventive when applied to the surface of the timber. This may answer to a certain extent while fresh, but it is a well-known fact that these grubs often eat their way to the surface through the paint and varnish upon a finished carriage, in which case the wood is no doubt impregnated, more or less, with turpentine.¹ Moreover, the discoverer of the species² found his specimens originally upon the yellow pine, which would imply that they had no special objection to turpentine.

Our experiments seem to clearly point to two remedies, as follows: One is to fill the pores with some substance which will prevent the deposit or absorption of eggs. The second is to select a suitable place for storing the stock, plank, &c., and to maintain a temperature of 100° of heat during the two months mentioned. Or, again, drying-rooms could be made, with screens of wire so fine that the beetles could not pass through them. Any of these three plans would help to banish the pest, always providing, of course, that places be selected which are positively free from the dust of former plank or stock piles. If we could add to these precautions the one last mentioned, that of cutting the timber during the months offering the least inducement to these pests, we might feel safe from their ravages; but, as we have said before, the demand for hickory makes this almost an impossibility. Hence, every experiment should be tried toward throwing further light upon the subject, and one important step will be gained if we dismiss all ideas that these larvæ or worms are in any manner connected with timber excepting as they are placed there by their parent, the *Lyctus striatus*.

IX. EXPERIMENTS UPON TIMBER CULTURE AT THE COLLEGE FARM BELONGING TO THE UNIVERSITY OF NEBRASKA.

The report of experiments at the college farm in Lincoln, Nebr., for 1880, gives the following results of experience in timber-culture at that station:

Timber.—The cottonwood in this locality is becoming seriously injured from the effects of a borer working in the body of the tree, causing it to break easily in the winds.

By computation, cottonwood trees growing on bottom land have nearly double the amount of timber that those on the upland have. Not that the trees themselves are much larger, but partly on account of more trees on the same ground, the bottom lands being a more natural place for them to grow.

On upland, soft maple trees twelve years old have made a little more fuel than cot-

¹Another writer has suggested benzine as a remedy, which under his experiments had never failed. He had applied turpentine without success.

²Thomas Say.

tonwood of the same age. Both were planted 4 feet apart in the rows, and the rows 7 feet apart.

We have not succeeded in getting soft maples, when planted singly for shade trees, to continue growing healthy and in good shape without mulching the ground and protecting the bodies from the sun by having slough-grass or something else tied around the body, so that the hot sun does not fall on the body of the tree. When mulched and protected as above, the tops have grown well balanced; when not so treated, they die in a few years or the top grows largely on one side of the tree.

The question was suggested as to whether trees that were 12 inches in diameter had better be cut down and new ones planted or let grow.

The computation was made with the following result: The tree 12 inches in diameter makes a growth three-sixteenths inch in thickness around the 12-inch tree; this, put into a round pole, makes it 3 inches thick at the base, and tapering to a point at the top of the tree, or about 30 feet long. To produce this amount of timber it takes the young tree near five years, or more trees than would be planted in the space allotted to the large tree.

Of late the *Catalpa speciosa* is being put forward as a desirable tree to cultivate, on account of its rapid growth and durable timber for posts.

For two years we have had both varieties, *Catalpa bignonioides* and the above. The *speciosa* variety has stood the winters. The *Bignonioides* has not nearly so well. Many of them were killed back to the ground, and some entirely killed. A part of the ground on which the *speciosa* was planted was mulched, and by accident fire got in and killed them to the ground; but they all came up again as vigorously as though nothing had happened. The trees that have been growing two years are but very little higher than the first year's growth. The second year's growing was made up largely of branches near the ground, thus suggesting the necessity of close planting or something else planted between them to supply the necessary shade to prevent so much side branching, and imitate the natural forest conditions. We have not experimented to see what variety they would do well with to supply shade.

To make the walnut grow more upright while young, we plant 4 feet apart in rows, and the rows 4 feet apart, and put willows in the rows between the walnuts. This was suggested by some walnuts being planted part among willows and part exposed to the sun. In four years' growth those among the willows and shaded were from 1 to 5 feet high, and nice and straight; those exposed to the full effects of the sun were about 18 inches high and very scrubby.

Arboretum.—We have obtained several varieties of forest trees for a collection. The following is the list and how they grow:

Those that have had two years' growth:

Basswood is doing well.

Black ash, all alive, growing very slowly.

Blue ash.

Kentucky coffee-tree, all alive, growing slowly.

Strawberry tree, all alive, good growth.

Hard or sugar maple, half alive, very slow grower.

Buckeye, two alive out of ten, medium grower.

Chestnut, one alive out of ten, medium grower.

Tulip tree, half alive, good grower, winter kills some.

White oak (*Quercus alba*), slow grower.

Wild cherry, medium growth.

Scotch pine, American arbor vitæ, Siberian arbor vitæ, Norway spruce, and white spruce were planted when small and have grown well. Ponderosa pine, with two trials, failed entirely.

Those of one year's growth as follows:

American beech, half dead, slow growth.

White birch, all alive, growth good.

Mulberry (*Morus rubra*), all alive, extra growth.

Red pine, two out of ten alive.

Swedish juniper, mostly alive.

Balsam fir, half alive.

Besides these, a number of evergreens were obtained from the Rocky Mountains at a late period, in time of drought, and a small per cent. are alive. The object in this collection is to get all the varieties of trees that will grow here, for comparison.

X. UPON THE FORESTS OF EUROPE AND AMERICA.

It is an unfortunate circumstance that some of the estimates of forest supplies that have been published lie under the suspicion of having been written in the interest of trade, and with the view of affecting prices favorably to those who had timber products or timber lands to

sell, or of those who wished to purchase. Of these, the former had a motive for representing a coming scarcity, while the latter would wish to have it believed that the supplies were abundant, for the present at least, and for some distant and indefinite time in the future. This unscrupulous misrepresentation of facts is common in all transactions and in every business in which property is bought and sold. It simply imposes upon the seeker after truth the necessity of caution in adopting the opinions of others until something is known concerning the basis of their estimates and the probability of their motives. The safer course of dependence upon official statements, unfortunately, leads but a little way further than as comes under official notice, and even in the best-regulated systems of forest management in Europe the extent and value of woodland on private estates is often estimated from data that may differ widely from the truth.

The following article upon the forests of Europe and America is from one who has long been intimately acquainted with the practical details of the timber trade in France, and whose opportunities for forming correct estimates in this line of business should enable him to present a reliable view of the subject, and, so far as we know, without interested motives.¹

1. *On the Necessity of Forests.*

One of the most important questions that presents itself to the attention of the principal producing and consuming countries in the article of wood, is beyond doubt that which relates to the forests. This especially concerns the production of Russia, Sweden, Norway, Prussia, Austria-Hungary, the United States and Canada; and as regards consumption, France, England, Belgium, Denmark, Netherlands, &c.

Until recent years, it would seem as though the supplies of wood could never come to an end, and that this natural wealth formed a kind of universal and inexhaustible mine, which it would be impossible to exhaust. A certain class of optimists, founding their opinions upon the ground that from the earliest period the world has always easily found all the wood necessary for its use, and this without having to depend upon the discovery of new forests, would pretend that it was ridiculous to borrow trouble so far ahead, as in all events there would be provided, in some way or another, the means of avoiding the dangers that they considered as only imaginary.

The pessimists, on the contrary, affirm that, as the consequence of working without limit or restraint of so great a number of private forests, in Europe and America, a true famine in woods must be the inevitable result before the end of this century. A summary examination of forest resources, as they are understood to be actually existing, taken in connection with estimates of the annual cutting, will enable us to form a somewhat definite idea as to the stability of foundation upon which this unlimited confidence of some and this gloomy apprehension of others, actually depend. We will then proceed to inquire as to the means that may appear, in our humble opinion, to be most practicable for reassuring the present and guaranteeing the future.

It is an unfortunate fact, and becoming more and more true, that the clearing of woodlands is encouraged, and, we may say, stimulated, by the formidable and continually-increasing general consumption, which leads to proportions vastly exceeding the normal annual production, as we shall presently show. There evidently results a most threatening danger, which has already been often pointed out with energy, and against which the general welfare requires us to adopt on every side the most effectual and decisive measures, which should be executed with activity and perseverance, if we would seasonably avoid the consequence of a lamentable crisis.

Taking a general review of the immense areas of ground, which various statistical works admit to be still covered with forests, it might at first sight appear that our fears were taxed by groundless apprehensions of exaggerated evils; but we feel assured that, considering the innumerable quantities of trees cut every year, the number prematurely destroyed, and the number wasted, it must be admitted that we should lose no time in trying to remedy, as speedily as possible, a condition of affairs so much to be deplored.

¹ Les forêts de l'Europe et de l'Amérique. Étude sur le Régime des Forêts et leur Reconstruction, par J. G. Lefebvre (du Havre), membre de l'Académie Nationale, Agricole, Manufacturière et Commerciale, Chevalier de l'Ordre de Wasa de Suède. Auteur du "Guide Théorique et Pratique du Négociant en Bois du Nord, et en Bois d'Amérique," etc., etc. Paris and Havre, 1879.

We ought not to forget that in addition to the economical value of the forests, taken as a part of the wealth of the country, and in the welfare of its inhabitants, their protection in a climatic relation becomes a necessity of the first importance. No one is so ignorant as not to know that the inconsiderate destruction of trees reduces the water-courses, and causes disastrous inundations. We believe that the multiplied benefits derived from the presence of forests are not enough appreciated, such as the sanitary improvement of marshy places, the moderation of the temperature, the protection of open plains against violent winds which have their force broken and their currents divided by the trees; and, finally, the prevention of prolonged droughts, which too often desolate regions of country where the wood has been taken off, as has been too often proved by examples down to the present time.

2. On the extent of Forests in Europe.

In our preceding chapter, we have alluded to the amount of land occupied as the principal argument adduced by the partisans of the *statuo quo* class of foresters. According to the most recent information, the total area of forests in Europe is estimated at 270,000,000 hectares (661,900,000 acres or 1,034,220 square miles), which is about 28 per cent. of the whole area of this division of the earth. Arranged in their order, the countries furnishing timber are as follows:

| Countries. | Hectares. | Acres. | Countries. | Hectares. | Acres. |
|----------------------|---------------|---------------|-------------------|-------------|--------------|
| Russia | 190, 074, 039 | 469, 482, 926 | Spain | 4, 747, 659 | 11, 726, 700 |
| Sweden and Norway . | 30, 509, 600 | 75, 358, 712 | England | 880, 195 | 2, 174, 082 |
| Austria-Hungary | 14, 721, 717 | 36, 352, 641 | Switzerland | 786, 000 | 1, 941, 420 |
| Germany | 14, 151, 262 | 34, 953, 617 | Portugal | 561, 000 | 1, 385, 670 |
| France | 8, 500, 000 | 20, 950, 000 | Belgium | 434, 896 | 1, 074, 193 |
| Italy | 5, 025, 893 | 12, 413, 956 | Greece | 350, 770 | 866, 402 |

The remainder is distributed among other countries not specified. If we admit that the above figures are correct, or rather that they are relatively exact, (but this is a point that might be much questioned), we should in the first place take into account the fact that there always exist some forests that are not workable, either on account of their insignificant yield, for the annual cuttings are often exaggerated beyond proper limits, or because they cannot be reached.

We should also not fail to remark that we often find tracts of land masked by a thick covering of verdure, that are in reality nothing but immense wastes occasioned by fires or storms, and which contain nothing but the wrecks and remnants of trees, and sometimes overrun with wood insects, some species of which in a little while may destroy whole forests, as was lately seen in Bohemia, where a million of cubic toises of wood were entirely destroyed.

These different causes or these enemies to sylvaculture, against which it appears useless to try to contend, very materially and, we may say continually, tend to diminish our presumed forest resources, which are very largely drawn upon by the ever-progressive increase of our general wants and sometimes further injured by malevolent acts. We may therefore be fully impressed with the conviction that the improvement and preservation of the forests, and especially reboisement, is a work of great magnitude and long duration. We should bring to its execution the concurrence of every people; and when indeed this great truth comes to be realized by the nations who have in this matter a common interest, we shall certainly arrive at a better understanding of the means best adapted to a profitable result throughout the world.

If we now approach the question of production and consumption in the principal countries of Europe that are now occupying our attention, we shall find conditions of a nature to convince the most incredulous as to the duty of the state foresters to seek without further delay for such remedies as the situation demands, so great is the actual peril, as we hope to be able to prove in the following chapters.

3. France.

In France the annual forest products may be estimated at about 36,000,000 stères (127,116,000,000 cubic feet), and the consumption on an average about 55,000,000 stères (194,205,000,000 cubic feet). We are therefore tributary to foreign countries for 19,000,000 stères, and this balance of cost on importations may be estimated according to kinds at from 100 to 120,000,000 of francs. A deduction is to be made from this for our considerable exportation of mining props, railroad-ties, &c., coming principally from the Landes, the South, and Brittany.

The following statement shows the difference of exchange in the value of woods

between France and foreign countries during the year 1876, derived from statistics obtained from the customs reports.

| | Importation. | Exportation. |
|---|---------------|--------------|
| Oak : Round and square, railroad ties stères | 25, 302 | 20, 431 |
| Oak : Round and square (other) do. | 28, 019 | 23, 973 |
| Sawn oak wood more than 80 millimeters thick do. | 4, 132 | 6, 724 |
| Sawn oak wood less than 80 millimeters (3½ inches) thick meters | 3, 365, 494 | 498, 230 |
| Other kinds : Round and square, railroad ties stères | 15, 162 | 40, 200 |
| Other round and square woods do. | 340, 938 | 205, 693 |
| Saw woods (other) more than 80 millimeters thick do. | 133, 306 | 20, 559 |
| Saw woods (other) less than 80 millimeters thick meters | 145, 944, 380 | 13, 088, 893 |
| Masts pieces | 599 | |
| Little masts do. | 889 | 6 |
| Spars do. | 75, 734 | |
| Hoop-poles do. | 24, 206, 534 | 12, 911, 368 |
| Poles do. | 2, 274, 918 | 9, 610, 179 |
| Oak plank do. | 54, 528, 380 | 1, 663, 166 |
| Other plank do. | 12, 298, 725 | |
| Fire-wood stères | 93, 863 | 53, 634 |
| Fagots bundles | 706, 587 | |
| Charcoal cubic meters | 77, 810 | 42, 551 |

These figures, compared with those of previous years, show a notable increase in the amount of importation, while the amount of exportation has remained about the same.

If we express the commercial movement in values instead of quantities, the document we are analyzing shows that the importation of building material amounted to 127,000,000 francs in 1876, against 97,000,000 in 1875, and 105,000,000 in 1874. The exportation of the same classes of products was 29,000,000 in 1876, 30,000,000 in 1875, and 37,000,000 in 1874.

Austria-Hungary, Russia, Prussia, and America aid in supplying our surplus wants by furnishing oak wood for cabinet-making, joinery, and cooperage, while most of the pine and fir timber indispensable in our civil and naval constructions is derived from Russia, Sweden, Norway, Austria-Hungary, Canada, and the United States.

We have, it is true, in Algeria, some fine forests of the evergreen oak, eucalyptus, thuja, Aleppo pine, caroub, cork-tree, &c., but the difficulties in the way of getting them to market, and above all, the frequent fires that ravage the forest products of our Algerine possessions, have hitherto prevented us from deriving the benefits that were hoped.

One of our colonies, French Guiana, is very rich in woods of exceptionally good quality, as regards durability and strength; among which we may mention the *palmiers*, the *bois de lettre moucheté* for marquetry, the *bois de rose mâle*, and the *bois de cannelle*, which are incorruptible and not attacked by borers, the *cèdre noir*, which is common, but which affects iron; the *paleturier blanc* for masts, the *balata rouge*, which yields a kind of gutta-percha, and which the Western Railroad Company employ as ties; the *carapa rouge*, or crab-wood of the English, the *acajou* (mahogany); the *hèvé*, or caoutchouc tree; the *caouaie*, the wood commonly used for masts, the *paleturier rouge*, the wood called *marmite de singe*, useful in cooperage and cabinet wares; the *coupi de surinam*, suitable for carpentry and the making of ties, but of a disagreeable odor; the *gaick de cayenne* or *fèvier de touka*, the *courbaril* used in naval constructions; the *bois violet* (or purple heart of the English) of a durability and elasticity that has been well proved; the *wacapon*, which is very hard, incorruptible, and not liable to the attack of insects, and the *bois de fer* (iron-wood), which is black, compact, and excellent for cabinet-making; but unfortunately all these woods, although found to be valuable, are found in extremely limited quantities in the market, on account of the cost of getting them out and the high price of their transportation to France.

Hitherto the northern countries have been able to supply France, England, Belgium, Holland, Denmark, etc., the deficiency which these countries demand, but these palliative measures appear to us to increase rather than diminish our fears for the future. It is, therefore, very evident that these foreign reserves, already attacked, will in their turn experience the penury which commerce will surely produce, sooner create, to the great distress of our commercial and industrial interests. In this event, if we consider wood as one of the agencies of human civilization, not only France but the whole world is threatened with a very serious disaster.

4. England.

If we pass to England, the country that imports the greatest quantities of timber, we shall find that our neighbors are much worse off than we are in respect to forest production. As already remarked in a former chapter, Great Britain has but few

forests and a production relatively very insignificant, while on the other hand, notwithstanding the conceded wealth and extent of her coal mines, which will assure the supply of fuel for its consumption, the United Kingdom is obliged to seek from the forests of Northern Europe and from her American possessions enormous quantities of wood. The official reports of importation during a series of recent years, will furnish unquestionable proof of this fact.

Official Table of English Importation, from 1872 to 1877.

HEWN TIMBER.

| | Cubic feet. |
|-------------|---------------|
| 1872 | 89, 016, 409 |
| 1873 | 103, 540, 149 |
| 1874 | 122, 335, 026 |
| 1875 | 84, 373, 033 |
| 1876 | 107, 884, 161 |
| Total | 507, 148, 778 |

SAWED WOOD, ETC.

| | St. Petersburg standard. |
|-------------|--------------------------|
| 1872 | 935, 560 |
| 1873 | 1, 035, 067 |
| 1874 | 1, 153, 105 |
| 1875 | 999, 342 |
| 1876 | 1, 243, 217 |
| Total | 5, 366, 291 |

VALUE OF IMPORTED WOOD.

| | Francs. |
|-------------------------|------------------|
| 1872 | 318, 592, 275 |
| 1873 | 430, 171, 909 |
| 1874 | 406, 648, 900 |
| 1875 | 350, 339, 650 |
| 1876 | 443, 082, 250 |
| Total | 1, 948, 834, 975 |
| Mean annual value | 389, 766, 995 |

We deem it of interest to present a summary of the importation by countries and provinces.

Square Timber.

FROM RUSSIA.

| | English cubic feet. | Value in francs. |
|------------|---------------------|------------------|
| 1872 | 12, 943, 950 | 13, 977, 800 |
| 1873 | 17, 035, 100 | 20, 257, 100 |
| 1874 | 24, 836, 600 | 30, 056, 000 |
| 1875 | 14, 664, 500 | 17, 271, 400 |
| 1876 | 16, 371, 450 | 18, 495, 675 |

FROM SWEDEN AND NORWAY.

| | | |
|------------|--------------|--------------|
| 1872 | 25, 494, 900 | 22, 761, 200 |
| 1873 | 35, 004, 850 | 38, 788, 400 |
| 1874 | 31, 140, 500 | 35, 142, 525 |
| 1875 | 21, 860, 300 | 20, 992, 125 |
| 1876 | 30, 638, 400 | 29, 853, 575 |

FROM GERMANY.

| | | |
|------------|--------------|--------------|
| 1872 | 13, 756, 250 | 21, 372, 175 |
| 1873 | 13, 140, 900 | 25, 227, 675 |
| 1874 | 14, 971, 700 | 27, 005, 250 |
| 1875 | 11, 297, 450 | 17, 779, 475 |
| 1876 | 11, 853, 350 | 21, 016, 300 |

Square Timber—Continued.

FROM ENGLISH POSSESSIONS IN AMERICA.

| | English cubic feet. | Value in francs. |
|-----------|------------------------|---------------------|
| 1872..... | 22,174,200 | 34,961,025 |
| 1873..... | 18,293,750 | 45,166,050 |
| 1874..... | 24,818,750 | 53,942,950 |
| 1875..... | 16,843,350 | 34,863,025 |
| 1876..... | 23,547,450 | 49,253,250 |

FROM VARIOUS OTHER COUNTRIES.

| | | |
|-----------|------------|------------|
| 1872..... | 14,762,350 | 25,978,500 |
| 1873..... | 20,094,900 | 37,619,975 |
| 1874..... | 27,602,150 | 50,494,700 |
| 1875..... | 19,601,650 | 29,863,500 |
| 1876..... | 29,504,100 | 37,664,250 |

Wood Sawed and Worked, etc.

FROM RUSSIA.

| | | |
|-----------|------------|------------|
| 1872..... | 31,723,850 | 38,268,625 |
| 1873..... | 37,733,800 | 55,981,065 |
| 1874..... | 96,882,150 | 76,303,450 |
| 1875..... | 42,143,200 | 55,194,250 |
| 1876..... | 50,239,300 | 69,790,375 |

FROM SWEDEN AND NORWAY.

| | | |
|-----------|------------|-------------|
| 1872..... | 76,159,750 | 83,740,400 |
| 1873..... | 78,762,600 | 110,779,600 |
| 1874..... | 76,026,300 | 123,175,675 |
| 1875..... | 63,243,800 | 82,170,550 |
| 1876..... | 82,955,200 | 109,814,505 |

FROM GERMANY.

[The amount of sawn timber imported from Germany into England is relatively very small, and is included in that of "various other countries."]

FROM BRITISH AMERICA.

| | | |
|-----------|------------|------------|
| 1872..... | 39,414,400 | 55,160,125 |
| 1873..... | 47,717,800 | 78,254,625 |
| 1874..... | 59,809,400 | 83,484,650 |
| 1875..... | 47,661,400 | 67,345,575 |
| 1876..... | 55,367,350 | 76,977,825 |

VARIOUS OTHER COUNTRIES.

| | | |
|-----------|------------|------------|
| 1872..... | 7,059,450 | 12,746,675 |
| 1873..... | 8,542,450 | 18,097,400 |
| 1874..... | 13,544,500 | 27,043,500 |
| 1875..... | 11,843,000 | 21,009,750 |
| 1876..... | 16,569,050 | 30,166,450 |

We may add that almost all these imported woods (pine, spruce, and oak) are employed in building and in the industries.

The English colonies are quite as favorably endowed with forests as are Algeria, Senegal and Guiana, but the woods are there much better worked. New South Wales has gigantic trees, of which the most remarkable is eucalyptus or iron-wood, which they export to India for use as railroad-ties. Australia has also several other species of the eucalyptus which are highly esteemed. The English Indies were formerly clothed

with forests which were devastated in a most barbarous manner, being looked upon as an embarrassment rather than as a source of wealth. But now as the want of wood begins to be largely felt, they have had recourse to severe legislative enactments to arrest the evil.

We will now examine the principal countries, the forests of which are constantly put under contribution to supply our wants, and which afford us so substantial and precious a resource.

5. *Russia.*

We first cite Russia, whose forests cover about 43 per cent. of her immense territory¹—that is to say, a region three and a half times greater than that of all France. The governments of Vologda, Archangel, Kerm, Viatka, Saint Petersburg and the Grand Duchy of Finland, comprise two-thirds of the forest wealth of Russia, and all the other governments together have but 63,000,000 hectares.² The state owns about 54 per cent.³ of the whole forest area, and the workings are done by the most rational and economical methods known in forestry.

Moreover the government occupies itself in the care of its possessions with a zeal and activity worthy of the highest praise, and at the same time it is conscientiously studying all the systems of reboisement. We feel confident that these persevering efforts will secure favorable results, as must appear in a better annual return from the woods worked by the crown.

Individual owners possess about 46 per cent. of the forests of Russia and Finland, but it is a shameful fact that many of these proprietors cut their timber in very bad condition, not only to the prejudice of their own interests, but to the discredit of the country. For example: the clearings are estimated at about 92,862 hectares annually, upon an area of 3,500,000 hectares. It is admitted that the cuttings should be made only once in seventy-five years, which would allow of but about 96,666 hectares a year to be cut upon such an area. It is easy to appreciate the inconveniences presented from so imprudent and improvident a practice, and it cannot fail to impoverish the country at a rapid rate, and this without the excuse of a serious necessity of affording land for agricultural cultivation. If we can believe another calculation that has been made approximately, that the quantity of wood consumed, wasted, and exported every year, as compared with the total increase of forest products during the same period of time, we reach the following result:

Admitting that nature provides 100 in each year for consumption, the exportation and destruction by the elements cannot be estimated at less than 137. It follows from this calculation that in twenty-five years almost the whole of the forests of the empire would at this rate be swept away. We are assured, however, that these fatal prophecies will not be realized, especially when we take into consideration the intelligence and the energetic power of the Russian Government, which it would certainly use as the necessity became apparent; but we ought to confess that it has in this affair no time to lose.

Throughout Russia wood is used profusely as a fuel. The railroad, the manufactories, &c., for the most part, use wood and charcoal, and consume enormous quantities. In many districts (except in the houses of the wealthy classes) culinary utensils, plates, platters, spoons, and forks are of wood, which take the place of articles made of metals or pottery, and the fabrication of these utensils amounts every year to over 48,000,000 pieces. All of these objects of first necessity are made from birch and basswood, the barks of which are likewise used for making sandals, boots, &c. These rude and primitive coverings for the feet, among the poorer classes in some parts of Russia, lead to an enormous consumption—estimated at over a hundred millions of pairs in a year. It is more especially in the governments of Viatka, Kostroma, Kasan, Vologda, and Nijna-Novgorod that the population are largely engaged in the making of the various articles above mentioned, and in these parts we find whole villages where the inhabitants are wholly engaged in working the basswood forests as their principal source of maintenance.

¹According to the Russian Forest Atlas, prepared by P. Wrekha and A. Matern, and published by the Russian Forest Society in 1878, the total extent of forests in Russia in Europe is 177,286,000 déciatines (=476,899,340 acres). The state forests amount to 106,632,000 déciatines (283,840,080 acres), of which 93,437,800 déciatines (251,347,682 acres) are stocked with trees. The forests generally form 39 per cent. and the state forests 20 per cent. of the total area. The number of déciatines of forests to an inhabitant is 2.5 to 1 as regards the whole forests, or 1.3 to 1 as regards the state forests. Ten percentage of state forests under aménagement; 7.4 per déciatine; the total annual cutting in cubic feet is ——— and the revenue 9.6 kopecs per déciatine.

²Equal to 155,610,000 acres.

³The percentage derived from the Russian Forest Atlas is little less than this, viz, 52.7.

It is also in these parts that they manufacture an immense quantity of mats from the bark of the basswood, or *tille*, which serves very generally in Russia for the baling of produce, the rigging of boats loaded with the cereals, and in the making of cordage, cables, and even sails, for use in their internal commerce. Formerly—that is to say, until the fifteenth century—basswood-bark was sometimes used in Russia in place of parchment, and there still exist some documents written upon pieces of this bark prepared before it was used. According to reports worthy of full credit, it is stated that from 700,000 to 1,000,000 basswood trees are cut every season, and this number forms but a very small part of the number of trees destroyed annually in Russia. We may form some idea of its extent from the statement that in Finland alone millions of young trees are cut every year. The principal kinds of trees in the forests of Russia are pines and firs, which are particularly the kinds sought after by foreign merchants, in various forest districts of Russia, in the form of masts, posts, beams, ship-plank, deals, scantling, planks, and boards of the qualities and sizes most convenient for commerce and the industries.

Russia also possesses, especially in some of the northern governments, a larch, which has hitherto been too little known, that has excellent qualities for many uses, and poplars, which for a long time could be used, as was thought, only for fuel, but which are now much sought after for the manufacture of paper, and also some oaks, of which the best furnish us with deals of a quality known as “crown,” so esteemed among our most celebrated piano-makers.

We may also mention the willows, or rather their bark, which contain a remarkably fragrant principle, which the Russians turn to profit in the preparation of the leather for which this country is celebrated, and which affords an object in commerce to the value of thousands of francs every year.

It is only a few years ago that 64 per cent. of the whole surface of Finland was still covered with woods, the principal kinds being pines, firs, poplars, ash, birch, beech, &c. The products of the forest, such as timber, fire-wood, turpentine, tar, potash, &c., then formed the principal resources of that country. The annual cutting of woods of proper age has already in the governments of Uléaborg, Wasa, and Viborg arisen to millions of trees annually, without the enormous destruction of young trees for the inclosures around their little properties and still smaller fields, and wood is used with prodigality as fire-wood at a rate that the most moderate estimates do not place below 754,000,000 of cubic feet a year.

From the numberless forest grants made to associations by the Russian Government, upon condition of complete clearing within a fixed time, with the view of afterwards giving up their lands for agricultural use, the parties to whom these grants were made have practiced a mode of working that is nothing less than devastation; but, on the other hand, the gaining value of wood has served to check this spoliation of which we have been speaking.

At the beginning of 1876 Finland had 299 saw-mills, of which 148 were run by water power and 151 by steam. During the following year new and important steam saw-mills were built adjacent to new points of exportation. Young trees form the greater part of the pine and fir trees cut in Finland, and it is easy to understand the almost fabulous quantity which is now exported under the name of floor-boards, and especially destined to the French ports of La Manche and l’Ocean.

The Senate of Finland has recently voted the sum of 750,000 francs for the purpose of cutting a canal that is intended to connect the White Sea and the Baltic. The question of great navigable and other routes intended to facilitate these communications is just now the order of the day in Russia, and should bring about a real revolution of economy to the benefit of the empire.

Directly following Russia we come to Sweden and Norway, which supply every year the greater part of our wants in the way of pine and fir of excellent quality and much appreciated in commerce and the industries.

(6.) *Sweden and Norway.*

In our day, as in times the most remote, Sweden has always been regarded as one of the best wooded countries in the world, and with the exception of some provinces in the central and southern part, which have been quite denuded, we may still affirm that, next to Russia, Sweden is of all countries in Europe the possessor of forests of great extent and value. As for Norway, the forest area is estimated at about 63,759 square kilometers (about 24,611 square miles).

The Scandinavian forests belong to the state domain to the extent of 15 to 20 per cent., the rest being in the hands of individuals or of companies, who hold title from the crown, either by location or as franc-fiefs. The best authorities estimate that in late years the annual destruction of trees has exceeded the natural production by one fourth; but we ought to add that this inconsiderate working should not be charged to individuals, for the land proprietors have for a long time made this matter a subject

of wise and intelligent observation, which had for its end not only their perservation but also their improvement and development.

To enable us to understand the importance of the Swedish forests, and at the same time avoid tedious details, we will give some interesting statements concerning the northern part of Sweden which is known as Norrland. This portion includes administratively five provinces—viz., Norrbotten, Westerbotten, Westernorrland, Jemtland, and Gefleborg.

In the province of Norrbotten, the most northern in Sweden, it is estimated that it takes two hundred and thirty years for a tree to grow to ten Swedish decimal inches (11.6 English inches) in diameter, at 15½ English feet above the ground. The least period in which a tree can furnish a product of any commercial value is about fifty years, and one hundred and forty years is about the average age of trees that are cut in that part of the country.

By consulting the average returns of late years we find that they represent about 648,627 trees a year. In Westerbotten the mean age of trees at time of cutting is one hundred and thirty years, and the number of trees taken annually is about 1,121,647. In Westernorrland the average age is one hundred and twenty years; the number of trees cut annually is 1,265,361. Lastly, in Gefleborg, the most southern part of Norrland, the average age is estimated at one hundred and ten years, and the ordinary cutting is 1,120,706 trees.

From these data, which apply only to the northern part of Sweden, and, it is true, to districts best supplied with timber, it will be seen that the annual cutting of the trees is not in proportion to the resources of the forests, especially when regard is had to the ever-increasing foreign demand.

The government has known these facts for a long while. Since 1865 two laws applicable to Norrland have been promulgated, having for their object the prevention of devastation of coppice woods, the regulation of cutting, and the designation as state parks of certain lands suitable for forest culture. These measures were prudent, but were soon found insufficient, and they have since been made more effectual by a new project of law for the province of Norrbotten, which forbids the cutting of trees under seven Swedish decimal inches (8.17 English inches) at 16 Swedish feet (15½ English feet) from the ground. This law, voted by the national legislature, took effect October 1, 1877, in the districts and parts of Haparanda, Neder-Kalix, Ranéa, Luléa and Pileå. The general council of Westerbotten, which includes the important districts of Skelleftea and Umeå, has not hesitated to ask the government to present a forest law identical with that of Norrbotten.

We sincerely hope that in time all the Scandinavian States will be wholly submitted to this indispensable regulation, which their interests demand, although it may prove a temporary inconvenience and a prejudice to present interests.

The value of forest products exported annually from Sweden and Norway amounts to 100,000,000 francs, mostly pines and firs for joinery and carpentry. As for the other kinds, such as birch, elm, poplar, basswood, oak, &c., these are worked to a considerable extent, but are mostly used in these countries themselves.

The industries of Sweden and Norway know how to skillfully draw a part of the advantages which their forests so remarkably offer. The whole world uses Scandinavian matches, the sale of which amounts every year to several millions of francs. They also send away some millions of francs' worth of dressed flooring every year, and the importation of this commodity into France tends to diminish by so much the number of planing mills in that country, since it can obtain, through this manufacture of floor boards, an article that is bought upon better terms than the French manufacturers can possibly afford in competition with this foreign industry.

Nor is this all: the manufacture of oils from wood is at the present time holding an important place, and is an industry that uses up not only the resinous trees but also their stumps and roots left in the ground after the timber has been taken off. These raw materials are submitted to a dry distillation—that is to say, are heated in retorts from which the air is excluded. They form a large quantity of products that find ready use in the various industrial applications of our day.

From the pine and the fir they likewise derive tar, resins, potash, &c., and we may add "pine work," wood ether, materials used in soap-making, &c. The trees which yield upon distillation an oil used in illumination are the pine and fir. Wood also serves for use in the preparation of an article that has become wonderfully developed in recent years—viz, in the form of pulp, designed for use in the manufacture of paper, of which considerable quantities are exported to France and England. Furthermore, the birch affords to the peasantry of Scandinavia a material for use quite as important as the basswood in Russia. Not only is this wood in great demand for fire-wood

In 1816 some French ports (Rouen, Havre, Dieppe, and Honfleur) alone imported from Sweden and Norway upwards of 60,000, St. Petersburg standard. This standard reckons as 10 dozen or 120 pieces 1½ inches thick, 11 inches wide, and 12 feet long, and equals 165 cubic feet of sawed wood, English measure.

throughout the interior of the country, but it is highly prized for a great number of uses. They make agricultural implements of various kinds from this timber, as also all kinds of household dishes and utensils. The bark of the birch tree is used for dyeing, tanning, and the protection of buildings from humidity. We might cite numerous other industrial products which are made from wood, but presume that enough has been said to prove how indispensable the proper management of the forests is to the welfare of the country, and the absolute necessity, from every point of view, it is to provide as promptly and effectually as possible the reserves which the future will require. This general advice applies especially to Sweden and Norway, which should certainly not forget the importance of their natural resources, which should be measured to suit the necessities of their population.

(7.) *Austria-Hungary, Bohemia, Roumania, Italy, Spain, and Switzerland.*

Next after the forest countries of Northern Europe we deem it proper to speak of the forest wealth of other countries, either because France may in time need, or has already drawn from them, for the supply of a part of its wants or simply as a subject of intelligent report. In the first class of these we should mention Austria-Hungary, and especially Bohemia, which is very rich in species and varieties that possess excellent qualities. The exportation of woods from this country has amounted in recent years to 75,000,000 to 80,000,000 francs in value per annum the kinds exported being mostly oak, pine, fir, birch, ash, &c. The oaken cask and barrel staves of Austria-Hungary may be said to be almost altogether absorbed by the French markets. We find, for example, that in 1875 the exportation amounted to 56,708,660 pieces, of which 52,225,324 were sent to France, and 4,483,336 to England. In 1876, of 39,615,613 pieces sent abroad, France took 34,574,385, and England 5,041,228. The total exportation of wood from Austria-Hungary, as reported by the customs, amounted in the eleven months from January to December, to 2,232,457 stères, worth 31,812,514 florins (\$15,429,069.29), while in 1875 it was 1,992,444 stères, worth 28,392,327 florins (\$13,770,278.59). The difference in favor of 1876 was 240,013 stères, worth \$1,658,790.70.

If we add to the exportation the amount of wood used in the country, it is evident that Austria may be justly regarded as offering now and for a time to come some very precious and important resources. Roumania likewise has some very fine and extensive forests, which in kinds of timber resemble those of Austria-Hungary, and which already appear in our markets in competition with those of Northern Europe. Italy sees its forest resources, still quite important, wasting day by day, and we would like to believe that the government intends to seek to remedy this serious condition.

As for Spain, although its timber resources have been much reduced, its annua, production amounts to about 15,000,000 francs. We may also notice Switzerland which furnishes us every year with a considerable amount of wood. The rural economy of this country is determined by the climatic and geological features of the country in such a manner that pastoral industries hold a first rank, the forests a second, and the culture of arable lands a third place. The forests cover about one-sixth part of the territory of Switzerland, a greater proportion than that generally found in Western Europe or even in England, but which is less than in the German States. It is not the Alpine cantons of Switzerland that hold the first rank in this respect; the long chain of the Jura, with its succession of vast plateaux, and its rounded sides descending by easy slopes to the plains, and with its climate less extreme, offers altogether more favorable conditions for forest growth, and here woodland property affords the principal source of revenue throughout a considerable portion of the Juristic regions.

Timber does not grow upon the Alps up to the permanent snow line, but for some distance below we find only some scrubby bushes that scarcely reach a few feet in height. A little lower down we find the *arole*, and then the larch, which endure in the midst of sleet and storm, and form magnificent forests as they descend into the high valleys and the lateral gorges of the Engadine. There are here, indeed, trees of singular beauty; their wood has a brown tint, the grain is close, and they afford for building purposes, and especially for inside finishings, a material of the very best quality.

From the elevation of 6,000 feet down to 4,000 the spruce is found almost everywhere, but more especially upon calcareous mountains, which they adorn with their elegant pyramidal forms and regular branches of an evergreen that is almost black. The silver fir and the *Pinus sylvestris* are found to some extent in this region, but they are less abundant. These elegant trees form not only an ornament to the mountains, but they are a providential resource to the mountaineers. The covering of his dwelling, his furniture, his inclosures, his implements, and his fuel are derived from these woods, and without them his country would be uninhabitable. It is quite useless to recite the infinite variety of uses for which the Swiss employ their wood, which furthermore affords an important material for exportation. The forest riches of Switzerland have this feature that is peculiar to them; they are owned almost entirely by the communes, and their working forms a most important source of income for the public

aid. Each member of the commune shares in the annual apportionment, according to his wants for fuel and for construction as these are previously ascertained. The share of a family is allowed on an average in the German cantons at 1.5 cubic klafters, equal to 5.83 stères (about 1.6 cords) and valued at about 25 francs. If we multiply this quantity by the number of families, which number in Switzerland about 500,000, we have a total of 1,112,718 klafters (about 1,186,860 cords). It is to be remembered that this estimate is liable to error, because in some cantons the proportion is different, and in some the rule of apportionment is unknown to us. The foreign exportation of wood in Switzerland now amounts to some 6,000,000 or 7,000,000 francs, and, judging from what we know of the internal consumption of the country, the total yield of forest products ought to amount to some 50,500,000 francs a year, which would give a yield of 60 francs per hectare of forests—a rate decidedly greater than that realized from the forests of France or Germany.

It would be a very fine result if the consumption could be always maintained on a par with the productive power, but this balance has long been broken to the disadvantage of the latter. The ever increasing wants of the industries and the absence or inadequacy of coal deposits are constantly augmenting the use of wood, and besides these the use of wood as a fuel in manufactories and by steamboats and railroads have caused the rapid destruction of woodlands in many portions of Switzerland.

The upper valley of the Rhine and those of Urseren, in the Canton of Uri, and the greater part of the valleys of Tessino, afford evidences of this imprudent waste in the dangers which it has brought upon the rural economies and the climate. In these Alpine gorges, the destruction of the woodlands has taken off the protection of the soil, and exposed it to the erosion of torrents to the utter ruin of the sodded slopes and the fertile soil. The temperature has gone down, in proportion as the wooded surface has descended, and the higher regions have been changed to desert regions of ice. The development of such a condition should not fail to excite a general anxiety. The public authorities have set themselves earnestly at work, and are now endeavoring to stop the progress of this evil. This is done partly by prohibiting regulations to prevent the undue and improper clearings, which have formerly been made, and partly by a systematic operation of reboisement of the tops and sides of the mountains. In some cantons, nurseries have been established at the public expense for supplying at a low price the seedlings of young plants to communes and to individuals. They have established courses of instruction in forestry, opened free to attendance, and have appointed inspectors and forest guards in cantons. A report is published annually, under the cantonal authorities, upon the condition of affairs and the benefits obtained. The importation of mineral coal by railroads has become an important item, and a rapid increase in the employment of hydraulic power in manufactories has come to the aid of this work of renovation, which we trust will be crowned with success.

8. *The United States and Canada.*

If we now pass to another part of the world, we learn that the United States, according to the last census, in 1870, has an area of wooded land amounting to about 380,000,000 acres of land, belonging chiefly to individuals.¹ It was estimated that 10,000,000 acres of forests are destroyed annually, and that not more than 10,000 acres are planted. It is especially in the United States the devastation of forests is going on upon an immense scale, and made in some sense the order of the day.

The railroads and manufactories are appalling consumers of wood, as we may infer from the fact that it requires every year the timber growing upon 175,000 acres of forests to supply the ordinary wants of railroad companies alone.

To this, we should add the unlimited working of forests by proprietors under the pretext of supplying the domestic consumption of the country in fire-wood, the industries, &c., and it would be well for the New World if it would but wisely reflect and apply the remedy to their situation that so seriously endangers its forest resources, which, being thus daily wasted, are still further destroyed by the fires that are set through the malevolence or the carelessness of man.

The gross annual consumption of large pine timber alone amounts to 16,000,000 loads, and the amount of other timber, according to reports made to Congress for the year ending June 30, 1870, is 20,000,000 more. If we take into account the immense development that has taken place since that date in the use of every description of round, flat, and hewn timber, the amount employed in building, and the importation of Canada, we cannot estimate it at less than 30,000,000 loads a year, a quantity more than twice as great as all the sailing tonnage of Europe and America together.

From what is above said, we may be able to form some idea of the condition in

¹In the census of 1870, and in all that preceded it, no attempt was made to ascertain the amount of woodlands, except as growing upon farms and private estates. If anything besides this was in any case reported it was founded upon uncertain estimates.

which that country will be found in the course of a few years, especially since a large part of the western country is only a prairie and without trees. In fact, the vast country drained by the Mississippi, and including more than half of the whole territory of the United States, has been justly compared by a special writer to an immense farm, having only a little clump of woods in its northeast corner, and we may see the justness of the comparison if we will but study the map of the country and notice the vast extent of plains within the territory described below the wooded regions of Michigan, Wisconsin, and Minnesota.

The Eastern or New England States, including Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut, and the Central States of New York, New Jersey, Delaware, Maryland, Ohio, and Indiana were nothing but one dense forest, but comparatively a few years ago, and considerable regions were covered with groves of the finest pine. These States are now almost wholly stripped of this kind of timber, with the exception of Maine, which still has some timber, and they are still wasting the supplies that remain, and are, in fact, obliged to purchase great quantities of lumber in Michigan and Canada to supply their own stock thus wasting away. South of the States above mentioned are the States of Virginia, North and South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Arkansas, Tennessee, and Kentucky. With the exception of the western part of Virginia they have no white pine (commonly called yellow pine), but, on the other hand, they have the pitch-pine and the cypress, which, however choice, can scarcely supply the place of the former. If we reflect that some of these States are the oldest in the Union—that these cuttings have been going on for many years, and that their supplies of pine and hard woods are attacked without hesitation, as well to meet domestic wants as the calls for exportation, we may readily see that it would be a wonderful thing if what is left should remain very long. The eleven States last above mentioned produced all together in 1870 a less amount of large sawn woods than the production and consumption of Pennsylvania alone, and but a little over half as much as was produced in Michigan.

To the west and northwest we find the States and Territories of Texas, New Mexico, Arizona, Colorado, Kansas, Nebraska, Dakota, Eastern Montana, Illinois, and Iowa, a large part of Missouri, the part of Minnesota west of the Mississippi, and the southern part of Wisconsin, almost wholly prairies and without trees. The whole western world, as we may call it, as well as New England and the Central States above named, are now chiefly tributary for building-lumber to the little stock of pine still left in the State of Michigan, and in the northeastern parts of Wisconsin and Minnesota, which is in all estimated at less than 170,000,000 loads.

On the Pacific coast we find Washington and Oregon, which alone have wood to sell, and which they send to markets further south, along the western coasts of North and South America. The remaining States of California and Nevada have about one-fifth part in wood, a quantity scarcely enough for the supply of their own wants.

To the north lies Canada, which some people suppose is one vast forest, without interruption or limits, while in fact the forests of every kind together would scarcely cover a tenth part. British Columbia, on the Pacific coast, may have some timber to spare, but in limited proportion. We find the Saskatchewan Valley a great extent of territory, chiefly prairies, and large enough, they say, to make thirteen States of the size of New York.

If we come to the Red River country and Manitoba, we find them without timber. We next come to Ontario, formerly Upper or West Canada. It was truly a magnificent forest country; probably without a rival on the whole globe, where we found in abundance the finest pine, ash, elm, and walnut that ever existed, but the greater part has been burned to clear the land for agriculture, or used for fencing, or applied to various uses in constructions, or sent out of the country. We now actually find no great supplies of oak, nor ash, nor elm, nor walnut, nor white wood. The oak that is still exported from Quebec comes chiefly from Michigan and Ohio, and the walnut and the white wood from Indiana, Ohio, or some other western State. They would have burned the pines in the same fashion to obtain lands for cultivation, had the difficulty from the great abundance of trees not been so great.

Pine in later years has had a considerable commercial value, but it is only the first qualities, known under the name of white pine deals, that will bear the cost of transportation. The province of Ontario employs at the present time a great quantity of pine for its home uses, and, excepting perhaps a portion of this timber on the banks of the Ottawa and its tributaries, it would be wise if it should act prudently and reserve its last trees for its own consumption.

We now come to the Province of Quebec, so located that the State of New York is a natural market. It is on the banks of the Ottawa and the Saint Maurice and their affluents that we find most of the available supplies of timber in Canada, to the east of the Rocky Mountains. Let us now inquire as to how long these two sources of supply can endure bleeding to meet the wants of markets in Europe and South America, and for the consumption that the country itself requires. It is these regions that supply most of the deals and pine timber that are sent in such great quantities

from Quebec, and delivered in great cargoes to the south and other countries, and which furnish to a large degree the wants of the province itself.

The countries yielding the spruce are chiefly the Lower Saint Lawrence, the district of Saint Francis, the so-called eastern townships and the Provinces of New Brunswick and Nova Scotia. If we reflect that these pine and spruce regions have been kept under contribution, for purposes of exportation and consumption, during the greater part of the last century, we should not be surprised to learn, from those best acquainted with these questions, that these timbers still remaining at disposal in the Provinces of Ontario, Quebec, New Brunswick, and Nova Scotia, will be entirely cut within a few years hence. The extent of wooded lands is still estimated at some hundreds of millions of acres, but we think it illusory to found any expectations upon such estimates, so long as there is no efficient control for assuring the protection of what actually exists; we also think that it would be prudent to mark down these deceptive numbers, because there are extensive tracts of country where, from the poverty of the soil, the coppice woods are not worth the cost of cutting and transportation, even to a short distance. As in the United States, we find in Canada millions of acres of "forests" so called, or supposed to be timbered, which have been ravaged by fires and storms, and still others in which the working is carried to such an exaggerated and ruinous degree that the practice is greatly blamed by the American press.

European countries have an interest in the preservation of the American forests of the United States and Canada, which have hitherto supplied their markets with timber suited for all kinds of uses.

In the United States, when we examine as to the extent of forests, the Southern States rank first, and we find in that section from 40 to 50 per cent. of the surface reported as woodlands. In the Eastern, Middle, and Northwestern States the proportion varies from 10 to 40 per cent., and in the Western and prairie region it is from 5 to 20 per cent. Illinois has 19 per cent. of woodland; Wisconsin, 29, and Iowa 16 per cent. On the contrary, Nevada, Arizona, Dakota, Colorado, Utah, New Mexico, and Wyoming, are almost wholly without forests. We present below, the production of pine of different portions of North America in superficial feet, or board-measure.

[Here follows a detailed statement of production in the different States, as shown by the census of 1870, ending with the estimate that the total production of the United States and Canada amounts to 243,000,000,000 feet, board-measure.]

In speaking of the production and the extent of the forests, we ought to be particularly careful not to undervalue the generally admitted importance of the subject, but on the contrary should endeavor by every trustworthy statement to show the exceeding amount of annual cuttings, as well in northern Europe as in North America, and its great excess above the normal production.

It might be objected by some, that even admitting the complete exhaustion of European and American forests, we would still not be without wood; that the Dutch East India colonies offer precious reserves of timber, as also do the English and French colonies in these distant regions—that we might find in the great Brazilian Empire giant trees that might be used in the most diversified industries, and that, in short, we would only have to seek in other parts of the world, new and vast forests, still unexplored. To this we reply, that, without denying the value and importance of these extreme resources, it will be a sad day for Europe when we shall have been obliged to have recourse to these distant countries, from the extraordinary difficulties that would attend the working of these forests, and the enormous cost of their transportation to our country, and it would be necessary to abandon altogether the use of wood as a fuel.

We propose in the following chapter to submit our views as to the means that appear to us the most easy and practicable, if not to attain, at least to approach the end we have in view, that is to say, to effect an improvement in the preservation of existing forests, and especially to secure the replanting which the wants of the future so urgently demand.

(9.) *On the preservation and restoration of the forests.*

Among the measures that appear to us to contribute materially to the preservation of the forests, we may cite as of first importance the Swedish law now in force in the Norrbotten district, and which it would be desirable to see applied to all other forest countries, as well upon the national domains as upon the estates of communes and of private owners. We think that all governments interested in the subject should bring before their legislative bodies propositions for a law that should have for its object to forbid, under severe penalties, the cutting of trees of certain kinds, generally employed for building purposes, until they have grown to a given diameter at 16 feet above the ground. We are fully convinced that such a regulation would be favorably entertained in all national assemblies. It is quite true that in such a case it would be necessary to create new schools of forestry, and to increase the number of agents, inspectors, and guards capable of exercising an active, intelligent, and national care of

the forests under their care. But these expenses of this establishment, that would thus open up a new and honorable career to many persons, would be light as compared with the benefits that in due time would be derived from this measure.

We have already alluded to the necessity of forests in a climatic point of view, but we deem it proper to return to this branch of the subject. It has been often shown that the climate of Europe is not the same as it formerly was. Everywhere the winters are milder, the summers colder, and the changes of temperature more sudden, and often of a kind that seriously affect human health. This disturbance of the climate may in a great degree be attributed to the clearing off of forests, which, with thoughtless disregard of consequences, has been done to a rash extent in many parts of the globe, and especially in the Old World. This explains the disappearance of the once flourishing cities that were founded in Greenland by the Danes about the tenth century, and which we know were destroyed by the ice.

Europe suffers from the effect of sudden changes of temperature. When in summer the winds blow from the northwest the air presently becomes chilled. If France had not, as some compensation, the winds from Africa, that have been warmed in crossing the great desert of Sahara, its temperature would be like that of the United States and Canada under like latitudes, which is much colder than ours. As for the remedy against these immoderate extremes which pass so abruptly from cold to heat and from heat to cold at the expense of our delicate organisms, we believe it may be found, sufficient for the need, in replanting.

It might be well to here indicate the principal kinds of exotic forest species that it would be convenient to employ. They might be divided into three classes: First, those adapted to northern Europe, and which should be able to endure the severest cold; next, those adapted to Central Europe, and that might be a little less hardy; and finally, some of the semi-tropical species that might be found adapted to Southern Europe. Already for a long period the French Government has, under a law enacted for this purpose, been employed in replanting the mountains—a task of enormous magnitude, but one that will, we trust, lead to a successful result.

These labors of *reboisement*, pursued with indefatigable zeal, and a skill and method that has won the admiration of other nations, have already been well advanced in our country, and on this account they may be cited as an example. It is generally known that for a long period, by the sowing of the maritime pine, we have been enabled to place an effectual barrier against the encroachment of sand dunes upon the sea shore; but it still appears to us that, to facilitate and multiply this restoration of forest wealth, still more might be done, especially in the way of engaging the co-operation of private owners in these labors.

Fully indorsing the views of a distinguished sylviculturist of Finistere, M. S. Reyvon, of Quimperlé, we would meet the objections that may be brought with regard to the first expense of these undertakings by granting assistance, calculated at so much per acre, to every proprietor or farmer who would undertake and execute an engagement to sow forest seeds that should be furnished by the State, either gratuitously or at a reduced price, on any waste lands, according to the method that should be found most appropriate for the circumstances of the case. We would also wish to see honorary distinctions bestowed upon those who should do the best work in the face of greatest difficulties and with the greatest success.

It cannot be too often repeated that evergreen trees perform a part in nature that is generally admitted to be the most important in the forest economies of the globe. It is especially among the conifers that we find vigorous species that delight in arid lands and that do not require a long period of time to yield profitable results. There is no soil so sterile, so sandy, so marly, or so argillaceous but that with intelligent yet easy care may be covered with freshness and shade. It is chiefly by the sowing of pines that the desert lands of Normandy and of Brittany, the chalk lands of Campagne, the swamps of Sologne, which had rebelled against every other culture, have been in our day regenerated and restored to salubrity, to the great advantage of these regions that had long been of no account.

When we learn that in the five departments of Brittany alone at least half a million of hectares (1,235,000 acres) that were worthless, have been made productive, we need not seek other evidences to prove the advantages that this encouragement has secured. The governments, the general councils, the arrondissements, and the cities every year award large premiums to societies and to regional and local exhibitions, and we deem it no more than just that sylviculture should be allowed to share in these advantages. The sacrifices made by the State for the general welfare should be regarded, so to speak, as so many checks drawn upon the future, for a longer or shorter time to be repaid from the revenues which these increased values will bring.

But it is particularly upon the agricultural societies, which count among their membership so many eminent sylviculturists and enlightened men, the duty devolves of lending their aid in the cause that we present. The means of these societies, their great and proper influence, and the ample means of action at their disposal if turned to this subject could not fail to prove a guaranty of success. If aided in the first ex-

penses the proprietors would furthermore feel a certainty that their labors would, in the end, prove a source of revenue, as they could be easily convinced by consulting the changes that have occurred in the price of wood used in the industries since the seventeenth century. Thus, in Germany, according to Dr. Röb, wood had quadrupled in price between the middle of the seventeenth and the middle of the eighteenth century, and from 1740 to 1830 the same rate of progressive increase was observed. Another learned German, Dr. Engel, assures us that from 1830 to the present time, wood has increased very considerably in price, amounting to even 300 per cent. According to him that which was worth 100 francs in 1840 was worth 150 in 1850, 203 in 1851, 260 in 1860, 360 in 1865, and 400 in 1877.

Within the United States prices have arisen 100 per cent. in some articles within the last eight years. The same thing is observed in Russia, and in Sweden and Norway, the rise in thirty-five years has amounted to from 150 to 200 per cent., according to the kind of wood.

We have thought it our duty to present the foregoing considerations, with the view of showing in an effectual manner and in the presence of even increasing prices, the value of the forests. The hesitation of some and the indifference of others in matters relating to *reboisement* cannot be excused and will even become a subject of blame from the moment when all the facilities and appliances of governments shall have been largely directed to this important work. We deem it proper to give a passing notice of approval of a practice that has for some time existed in the departments of Central France. The peasantry of that region are generally small proprietors, and whenever a child is born in a family the father never fails to plant some trees in his grounds, the number bearing some proportion to his resources. When this child comes to marry or set up in business the trees thus planted are cut down and sold, forming a little endowment which in these industrial regions becomes the starting point worthy of notice. Finally, if we remark that in the general totals of the annual production of all the forests of the old and new world from three-fourths to seven-eighths of the wood is used for fuel, and only from a fourth to an eighth part is employed for civil and naval constructions, in our opinion every nation ought to be deeply interested in restricting the use of wood as a fuel to the least practicable point. To reach this result as far as is possible we should appeal to the governments and ask of them assistance for the benefit of the following:

1. To companies actually occupied in search for coal with probable success.
2. To companies for working more largely, and by new processes and improved appliances, the great peat deposits of which France has more than 1,200,000 hectares (2,964,000, acres), and which might thus be given up to agriculture after the peat is taken off that covers the vegetable soil. In Switzerland, in the Grisson Alps, where search has been made for peat, they have come upon a deposit of 10,000 feet square on the surface where it is 14 feet deep.

Peat has been neglected for a long time, and it is only since the price of fire-wood and coal has come up that the ancient prostrate forests have been called to the attention of progressive men, who have already derived advantages from this source, but which tends to still greater development as the working of peat becomes better known. In some parts of Germany peat is an important item, especially in Bavaria, where it is abundant and where it has even been used as a fuel in locomotives since 1844.

It will be remembered that mineral coal was for a time scarcely accepted in France for the warming of apartments, and nobody would wish to have it on account of its offensive odors and its unhealthy gases. Now its use has become general and yet this coal retains its odors and its gases—but imperative necessity has overcome all repugnance to its use. It would be the same with peat, and a time will come, when the product of the peat-beds, purified and compressed into form for convenient use, will meet with no great difficulties in forcing itself into use for industrial and domestic fires, a result that is worthy of encouragement as it will lead to economical results of value to the country, and we submit this as worthy of strong and intelligent encouragement.

XI. THE EXPENSIVE AND WASTEFUL USE OF TIMBER AS A FENCING MATERIAL.

In settling a new wooded country, where no crop could be sowed or planted until the native forest had been cleared, the first pasturage was the wild-wood, and the pioneer's cattle wandered at will wherever the ground was not prepared for cultivation and actually in some growing crop.

The abundance of material afforded a cheap and easy means for fencing, and we may readily understand how strong and well-kept fences

would come to be regarded as among the best evidences of good farming, and their absence as a token of indolence and a strong indication of scanty means. In the early days of such a country the average settler is indeed poor, and he would look upon it as a hardship if the few head of cattle that he owned could not ramble in the woods and pasture along the highways; and there were always some in every township who scarcely owned an acre of land, but who often had a cow or two that depended altogether for their summer keeping upon what they could pick by the roadside, and in the uninclosed woodlands of their neighbors, or of owners unknown. These farmers without a farm naturally look upon the scanty pasturage of the woods very much as boys regard the nuts of the forest—as the property of whoever chooses to appropriate it, without much regard to ownership; and in our own account of the origin of forest fires in the preceding pages of this report, it will be seen that not a few of these fires are every year set by landless owners of cattle, with the view of securing better feed for their hungry animals, upon land not their own. Thousands of acres of timber might thus be ruined to accommodate half a dozen head of miserable cattle.

But this primitive idea of fencing cattle out belongs to the rude and early stages of a country's settlement, and is sooner or later sure to be followed by one in which personal and proprietary rights are more clearly defined, and it comes to be established as a principle in law that the owners of farm stock must keep it upon their own premises, and that they become liable for any damages that may result from their trespass, whether the injured party has fences along the highway or not. It now becomes the duty in the owner of cattle to keep them *in* instead of *out*, and the privilege of the owner to appropriate to his own use whatever may grow upon his own land, even out to the beaten tracks of the highway, if there be anything outside the margin of his road-line worth saving. In this advanced stage of civilization, and this better definition of rights, the vagabond cow must be yarded or tethered, or the owner must pay pound-fees, as well as damages; for under the conditions we have assumed there will be no uncertainties about title, and no land without a recognized owner. Each owner feels a common interest in the maintenance of personal rights, and a public sentiment is created tending to the establishment of customs that may even acquire the full force of law in the absence of the expressed provisions of a statute.

Having thus noticed the origin and tendencies that govern our ideas of a fence law in the settlement of a wooded country, let us consider the question as it is presented upon the treeless plains. Here one of the first and most convenient, and often the most profitable, pursuit is pasturage. The herdsman needs a ranch and some few improvements that he can call his own, but his stock ranges far and wide, over lands of whose ownership he may neither know nor care; sometimes under keepers, and sometimes without, and it may be that his herds wander in quest of food, or drift before storms, until they are hundreds of miles away, the owner neither caring how they fare or knowing how they number, except at the time of branding at the annual "rounding up." The cattle baron is an enemy to cultivation of every form, and where he can influence the legislation of a country there are no fence laws and no lands but that lie open for the range of his stock. In short, he is as indifferent to the rights of property on the plains as is the poor pioneer in the woodland, so far as pertains to opportunities of pasturage and the rights of unknown or absent owners.

If those engaged in this interest were to attempt the enactment of a

fence law it would stipulate that no grain should be sown unless securely fenced in, and that in case of damages to their stock from over-feeding, where the fences were not sufficient to prevent the inroads of their cattle, the owners of the grain should pay the damages that might result to their cattle from this cause.

In recent years the owners of the land along streams, in the grazing States and Territories, have inclosed large tracts with wire fences, and this has been made a subject of bitter complaint on the part of herdsmen, who were thus cut off from the opportunity of watering their stock. From one point of view these streams are the common property of the country, and public policy might require that access should be allowed for the common enjoyment. But the riparian owner holds the title to the land, and upon every principle of justice he should be protected in its enjoyment. The most that could be required of him would be a right of way at certain points where most needed, in the same way that a highway might be laid out across his land for the public convenience. If its proximity to a river gives it superior value for pasturage, it is his opportunity and affords no just ground for complaint from others not thus favored, than has the owner of a broken upland against the more lucky proprietor of the rich intervalles below him. The fencing of private property under such circumstances, can be regarded only as the assertion of private rights, and should be looked upon as the beginning of a system of appropriation of land by its proper owners, which should finally lead to a clear definition of boundaries between individuals, and forever terminate this nomadic custom of the plains.

In the earliest phase of settlement and cultivation in a treeless region, the stock must be herded or tethered, and we get glimpses of pastoral and shepherd life, about which so much has been said and sung by the poets, but which on near acquaintance fades out into the most tame and commonplace of all human occupations. The practice, originating in the necessities of the private owner of both the grain-fields and the cattle, in due time becomes sanctioned by statute, and we have the "herd law" of our Western States and Territories, which declares that cattle shall not be allowed to range without sufficient keepers, and practically leads to the same conclusion as our modern fence laws, namely, that the owners of stock shall keep it upon their own lands, or pay all damages that may result from its trespass.

Having thus arrived from opposite directions at a common principle, let us next consider the economies that may be realized in the matter of fencing, and the extent to which these may be carried in the practical workings of the farm.

With the increasing values resulting from the rapid waste of our forests, it will scarcely be denied that wooden fences are in many parts of the country becoming expensive luxuries, and there are now few regions where we can really *afford* to make post and rail fences of black walnut or white ash, or board fences of pine. Our rail timber is worth too much for railway ties, bridge and mining timber and other uses, for which a ready market may be had, and wherever a substitute for wood can be found it should if possible be preferred. Live hedges have great merits, with some minor faults, which have often and ably been presented, and are getting to be pretty well understood. Stone as a fencing material is always acceptable, whenever it can be easily had, and it often presents advantages in the way of cheapness and durability superior to every other kind. A simple ditch and bank, or a wall of sod, or of adobe brick, may in some localities be preferred, and in very

many cases, if we would but realize the fact, we could *do without* much of the fencing that is actually used.

In coming to this conclusion we will admit the necessity of dropping some of the ideas of neatness and comfort, which we may have been accustomed to attach to a well-fenced farm, and seriously ask ourselves how much of this expense is for luxury and how much is for actual need. As a general rule we could scarcely dispense with line fences between farms where either owner may have occasion to use a bordering field for pasturage, yet none but those familiar with prairie farming in the newer States and Territories can well understand how very readily a road-side fence can be spared, and how a large amount of stock can be managed with a comparatively small cost for its inclosure.

Our fields are usually right-angled and four-sided, and those perfectly square require relatively less to inclose than where they are oblong. The amount of fencing needed on a square mile of land, in fields of different sizes, is shown in the following table :

| Number of square fields in a square mile. | Acres in each field. | Miles of fencing required. | Rods of fencing required. | Rods of fence to each acre in the mile square. |
|---|----------------------|----------------------------|---------------------------|--|
| 1 | 640 | 4 | 1,280 | 2 |
| 4 | 160 | 6 | 1,920 | 3 |
| 16 | 40 | 10 | 3,200 | 5 |
| 64 | 10 | 18 | 5,760 | 9 |
| 256 | 2½ | 34 | 10,880 | 17 |

In inclosing separate fields the amount required is nearly double that needed where both sides of the fence are accommodated by the inclosure, and when the field is small the cost becomes great, as shown by the following table :

| Acres in separate square lot. | Rods around. | Rods of fence for each acre inclosed. | Acres in separate square lot. | Rods around. | Rods of fence for each acre inclosed. |
|-------------------------------|--------------|---------------------------------------|-------------------------------|--------------|---------------------------------------|
| 1 | 50.56 | 50.56 | 25 | 254.56 | 10.18 |
| 2½ | 80.00 | 32.00 | 50 | 357.76 | 7.15 |
| 5½ | 113.12 | 22.62 | 75 | 438.16 | 5.84 |
| 10 | 160.00 | 16.00 | 100 | 505.96 | 5.05 |

We are entirely without data for showing the actual amount and cost of fencing in the United States; but it would be safe to affirm that it might be reduced from a third to a half without serious inconvenience. In the case of wooden fences, the decay and labor of maintenance cannot be less than 10 per cent. of first cost, and must increase from year to year, as new demands for timber may arise and its market value advances. The durability of posts may be increased by charring the outside on the end set in the ground, and timber from which the bark has been removed will generally last longer than where it is allowed to remain. If cut in fall or early in winter it will last longer than if the cutting is done in the spring or early summer months. In older coun

tries various modes of preparation are employed to increase the durability or improve the quality of timber, but these are generally too expensive for fencing materials, although very profitably used upon railroad ties and timbers used in other exposed places.

To an American traveler there is nothing that more strongly attracts his notice in Europe than the general absence of fences. They are generally seen along the sides of railways, where they are often in part composed of a hedge and ditch, with one or two rails supported by posts; but elsewhere they are the exception, and in some parts wholly unknown. It is also a matter of surprise to him to see how closely pasturage can border upon cultivation, and how, under the watch of the keepers and their dogs, the domestic animals become accustomed to these restraints and obedient to their orders. As a general rule they scatter but little, and move from place to place in somewhat compact bodies. Being always in company with their keepers, such animals become very gentle, and sometimes appear to be so trained that they will follow their keepers.

Along the public highways in the older settled parts of Europe, there is generally a ditch upon each side, with a bank of earth, the roadway being often raised above the level of the adjacent fields by the addition of finely pounded stone for repairs, and this when well trodden and smoothed down makes a solid and permanent road at all seasons. The line of roads is marked on each side with rows of trees. In Germany these are often apple trees; in Italy sometimes the mulberry or the olive, and in France and other countries often the Lombardy poplar. They are not close enough together to prevent the roads from drying up soon after a rain, but they serve as guides to the traveler, they afford him an agreeable shade, and shelter the country somewhat from the winds. The custom is commended as worthy of imitation, especially in the prairie regions of the United States, where such guides would be very useful. They should, of course, be under the local road authorities, and under a provision of law that should regulate their maintenance and provide for its expense.

XII. UPON THE BEECH AND ITS USE.

The European beech (*Fagus sylvatica*) is nearly allied to the American species. (*F. ferruginea*). The latter has longer, thinner, and less shining leaves than the former, and by some botanists two distinct species have been recognized: the *Fagus ferruginea* and the *Fagus sylvestris*, on the red and the white beech, so called from the color of the heartwood; but these shade into each other by insensible degrees, so as not to be distinguishable, and are now generally regarded as varieties of the same species. Cut-leaved, weeping, and other varieties of the beech have been introduced by cultivation or discovered accidentally growing, and afterwards multiplied by grafting. Some of these varieties are distinguished by a coloring of the foliage, such as the purple or copper beech, which is propagated from a tree discovered by accident in a wood in Germany towards the end of the last century, and supposed to be still standing. It is said by Loudon that "in early spring, when the leaves of the purple beech are agitated by the wind, during bright sunshine, their clear red gives the tree the appearance of being on fire, an effect, Bose observes, so truly magical, that it is scarcely credible by those who have not seen it." Sometimes, upon a cut-leaved variety of the beech, a single spray will be found from year to year with leaves of the normal form, as if nature was making an effort to return to the original type.

According to Lorentz and Parade,¹ the beech-nuts for seed, should be gathered and preserved in the same manner as acorns; and Hartig points out more fully the mode of preservation that has been found most successful. Having spread the nuts in an airy place, they should be turned every day until the humidity is evaporated that might otherwise cause them to mold. They may then be piled up one or two feet deep on the floor of a dry chamber, and covered a foot deep with straw to protect them somewhat from the frost. In this way they may be kept from autumn till the next spring, but they would scarcely retain their vitality beyond the first year after growth.

The goodness of the seed may be judged by its plumpness, color, and taste. A rancid flavor indicates a poor quality. From its delicate nature, the beech can scarcely be sown in an open ground, and even the shelter of grain will not answer, as in some other trees, because the young plants will need protection for several years. It is accordingly necessary to begin some time beforehand to prepare the ground where we intend to start a beech plantation by artificial means.

For this purpose, when the land chosen for planting has been sufficiently worked, the ground is marked off into lines, and in each alternate band they sow some tree having a rapid growth, such as birch, elm, pine, &c., or they may economize by using the furze, and if we wish to gain time these may be set out instead of being sowed; but it is not until they have gained sufficient height for shading that the beech nuts can be planted along the intervening vacant rows. This protection should be kept until the young plants have grown to some size, or at least until large enough to endure full exposure, when the secondary growth should be taken out. Sometimes this mode of planting cannot be followed, as for example where the surface is highly inclined, in which case the clearing might lead to an erosion of the land. In this case it will be necessary to lay out the ground as usual in horizontal bands of two or three feet in width, the alternate ones being prepared by previous planting, while the others remain uncultivated. Then, after planting the nuts, a part of the protection may be taken out at one time and a part at another, so as not to expose too much of the surface at once. These difficulties in starting a beech forest should lead us to prefer some other species, where we would wish to plant entirely vacant lands; or, instead of sowing the seed, to plant the beech itself from nurseries as the surer way to success. It is particularly in stocking void places in the woods, or a coppice that has been spent, or in grounds overrun with whitewoods and brambles, that we may start the beech nuts with best results. In these cases even it will sometimes be convenient to set some young plants. In planting the seed, it is well to throw several into one hole, because some of them may prove barren. In such cases where the young beech tree, have grown sufficiently strong, the other kinds should be cleared away. The nuts should not be covered more than 15 to 30 millimeters (0.6 to 1.18 inches); according as the soil is more or less compact. The surface of the soil should be well broken, for otherwise the large seminal lobes could not work their way through it.

Beech nuts sown in November (in France) come up in five or six months, but if sown in spring they come up, if the season is favorable, in from three to six weeks. For a full sowing it requires 8 to 10 hectoliters per hectare (9.19 to 11.49 bushels to the acre), and for partial sowing proportionally less.

¹ *Cours Élémentaire de culture des Bois*, 2d ed., p. 436. The mode of planting that follows in the text, is translated from this authority.

Cotta, in his treatise on the cultivation of wood, describes a mode of sowing the beech nut without providing a shelter, which he says succeeds well. It is as follows: The ground being laid off into lines, they dig in the middle of the band to be cultivated a channel from 4 to 5 inches deep, and about the same in width, and along the bottom of these they sow the nuts. As soon as the plants are up, they cover them by drawing in the soil so as to completely cover them up to the base of the seminal leaves. It appears, says Cotta, that it is the stems of the young beeches that suffer most from atmospheric influences, and that if we can in any way protect this part the young plant will survive without shade. The author here cited deserves the greatest confidence, and we are the more willing to rely upon his statement from a fact within our knowledge that entirely confirms his theory.

In the forest of Compiègne, belonging to the civil estates, there was made, some years since, some very considerable plantations of different kinds, and among the rest of beech. Usually the trees planted, that come from nurseries, are not finally set out permanently until they have been once reset in the nursery itself. But with the beech in particular, as we know how difficult it is to get it started on an open ground, we should procure young plants which have been subjected to this first transplanting when taken from the woods where they spring up abundantly. For this they take by preference the plants just up, with the cotyledon leaves still on, which they take up with the blade of a knife, and then set out in a nursery, on a cloudy day, in little furrows, like those described by Cotta, always taking the precaution to bury them entirely up to the seminal leaves. If the summer is very warm, they will lose many plants, but those that survive, and there is generally a great many of them, become thenceforth strong enough to endure all kinds of vicissitudes in the weather. We describe this interesting process to induce foresters to make a trial of it in various soils and in different climates; for it will be a most useful achievement in silviculture if we can find a way for cultivating a species as valuable as the beech in open grounds.

In describing the conditions best adapted for the growth of the beech these authors mention it as one of the most widespread and the most useful of the trees of Europe, preferring a temperate climate, but nevertheless growing upon mountains as high as those where the silver fir prospers, and even higher, it being found in the Alps as high as 1,500 meters, and among the Pyrénées as high as 1,800 meters above the sea-level. It would, therefore, grow in any part of France, excepting upon plains and on the sunburnt hills of the southern departments, always preferring an exposure to the north, northwest, or east, but never to the south.

Excepting in a dry sandy soil, a compact clay, or a marsh, the beech would prosper in almost any soil, if sufficiently comminuted, but it especially preferred a light loamy soil well mixed with pebbles, but did not require any great depth. Its blossoms, which appeared in April or the 1st of May, with the first leaves, often suffered from spring frosts, and the tree only bore nuts at intervals of several years. This fruit ripened and fell in October of the same year that it blossomed, and although not as heavy as the acorn, it usually fell not far from the tree that bore it. The beech does not usually bear fruit till fifty years of age or over, but in fertile years we may, in exceptional cases, see younger trees loaded with fruit. The young plants require shelter for several years, but appear to suffer less from the cold than from the solar heat, which they cannot endure. The foliage is very thick and abundant, and

its shelter is dense. Its roots are strong and run horizontally near the surface, never striking deep into the soil like those of the oak.

During the first fifteen years the beech grows very slowly, but it then, when it has gained some substance, becomes robust, and pushes up with great vigor. In soils suited for its growth, it rises to a height of 40 meters (about 130 feet) with a diameter of a meter or a meter and a half at the base; and it will, sometimes, prosper three hundred years.

The wood is scarcely suitable for carpentry, being able to endure neither moisture nor atmospheric changes. It can only be applied to this use when thoroughly seasoned and exposed to the fire until the surface is slightly charred. It is used, however, for some pieces in vessels that are entirely covered, or those that are always under water. Beyond this, the wood has a general range of utility, being one of the best for splitting, and suitable for employment for cabinet-making, marquetry, agricultural implements, carriages, turnery, round boxes, measures, &c. It is used for making oars for vessels, the handles of forge hammers and other implements, and its use for making wooden shoes is very large. It is to be observed that they never think of splitting beech excepting when it is green, but that before it is used it should be thoroughly seasoned, as it is very liable to shrink. This wood makes an excellent fuel and the best of charcoal. Its nuts mingled with acorns, are used in feeding and fattening swine, and a considerable profit is derived from this source. The right of gathering the nuts is sometimes sold, and they become a precious resource in a country poor in grain. The fruit is also gathered for the extraction of oil, which is very good for eating when pressed cold. It is better for burning, and gives less offensive odor than most other oils, and is successfully used in domestic economy and in the arts.

When the beech is grown to timber of full size, the proper age for cutting is from 80 to 140 years, but usually they choose 120 as the best period, at least when the forest is not situated in a very rich soil, or a very mild climate, in which cases the timber comes to perfection earlier, and is more liable to rot within,¹ rendering it preferable to reduce the period to one hundred or even to ninety years. A meager and shallow soil, which shortens vegetable life, will of course reduce the period of cutting.

In cuttings made preliminary to a natural reseeding, the reserves ought to be rather numerous, and composed of the strongest and healthiest trees. This shady condition is all the more needed by the beech, as the seed is heavy, and does not fall much away from the tree, and because the young plant is very delicate, and needs the protection of a thick covert. A cutting thus left should be allowed to remain until the seeding is completely assured, as we may judge from the appearance of the plants, that should have some strength and be at least from eight inches to a foot in height. We may then proceed with the secondary cutting, which ought to be done with much caution. In soils having a favorable exposure we may remove the reserves little by little, still leaving a part of the shade; but if the soil is dry and warm only a very few trees should be taken out the first year, and then more and more, so as to gradually accustom the young beeches to the atmospheric influences. When, by the aid of several cuttings, the undergrowth has grown to twenty inches, to two feet, or even to a meter in height, the time has come for a final cutting of all the large timber left. Generally

¹The kinds most liable to rot within, in substantial soils, appear to be those which have a thick covering and much moisture, favoring the formation of humus.—(*Lorents and Parade.*)

it is of no importance at this last cutting to reserve any trees whatever for extraordinary growth, for this timber is of no account for carpentry, and when it is 90, 100, or 120 years old, it is fit for every use to which it can be applied.

As the roots of the beech are tracing, while those of the oak strike very deep, the first gets its support from near the surface, and the latter from the subsoil. It therefore results that they agree very well together without interference, and with abundant nourishment we may generally remark that these mixed forests of beech and oak grow more rapidly than where the oak is alone. Another reason of this better growth is that in such a mixture, the beech, by its dense foliage, preserves a greater humidity, and enriches the soil more abundantly with humus than the oak would do alone.

As the oak is of the two kinds the most valuable wood, it is best, if it forms a principal, or at least half part, or even but two-fifths, to fix the period of general cutting at the age best suited to that kind, without regard to the beech, which can stand, as we have seen, till it is one hundred and fifty to one hundred and sixty years old, when the soil is favorable. When the proportion of oak is quite small, the period may be reduced to one hundred and twenty to one hundred and forty years, except, that in such a case the best trees should be saved to grow on through another period. In the cuttings made with reference to self-seeding in such a mixture, the amount of shade may be less, partly because the young oaks need more light and partly because of their more rapid growth they will themselves soon assist in shading the young beeches. The final cutting should in these cases be mainly made for the best interests of the oak. It will often happen, notwithstanding every precaution, that in these cuttings for regenerating the forests, the young beeches will crowd upon the oaks, and occupy too much of the land. This happens generally after years very prolific in beech-nuts, which may happen to be sterile years with the oak. In such a case we should endeavor, by artificial means, to restore the proportions by bringing acorns from other parts of the forests, or from other places,¹ and scattering or planting them about where needed. If this cannot be done the same year that the beech-nuts fall, from the absolute sterility of the oaks of that vicinity, it may be done the next year; but if it cannot be done within several years, it would then be better to obtain young oaks three or four years old, and plant them among the beeches, cutting them down to the root at the time of planting so as to compel the roots to send up a strong shoot to the level of the young beech tree.

In the cuttings for improvement, made from time to time, as the forest is coming to full maturity, it is easy to regulate the proportion of the two kinds by giving preference to one, or by cutting out the other; but in doing this, it is highly important to remark that the time of these cuttings should be well chosen, and that the operation be done with much intelligence, so that a vigorous beech shall not be sacrificed to save a sickly or defective oak, that could never come to acquire valuable qualities if left.

A mixture of the silver fir and the beech is also quite as favorable as that of the beech and oak. Nature affords us frequent examples of this, and it is a sad error that has led certain foresters to destroy in these forests all the broad-leaved species, for the sake of having only resinous kinds; and everything tends, on the contrary seems to command us, to keep a

¹ Usually the trees around the outskirts of the forests or along the roadsides are more fertile than those in the interior of a massive forest.—(L. & P.)

proper mixture of the two. In fact, in these mixed woods, we observe that the silver fir takes a remarkably fine growth, and we further recognize the fact that the damages from winds and from insects are not so much to be dreaded in this case as in forests of resinous trees alone. As for the time of cutting, the same period agrees well enough for both; the young seedlings have about the same temperament, and therefore a natural reseedling can be secured without difficulty. In the different stages of their growth, the two kinds keep along about equally, and it is easy to make the periodical cuttings in the interests of both. In short, they prosper on the same kinds of soil, in the same climate, and in the same exposures. They do not differ greatly in the uses to which they may be applied, and it is evidently to the advantage of the proprietor, the more especially since it is easy for him to give the fir the advantage, whenever his interests make this his preference.

As for the reproduction of the beech by coppice growth, it cannot be denied that it does not grow well from the stump. The bark adheres too closely to the wood, and its tissues are too close to admit of the easy development of shoots; and there is, furthermore, something in the peculiar organization of this tree, which does not allow it to prosper as a coppice growth, especially when we cut it down close to the ground and thus expose the stumps to rapid decay.

It is a general rule that in cutting trees with the view of their reproduction from the stump, besides taking the time best suited to this end, which is very early in the spring, the stump should be rounded off so as not to retain the water, and in the beech that at each succeeding cutting the section should be below the knot caused by the cutting previous, but still, if possible, in the new wood, as the bark of this part is not so hard as the old bark. But this cannot always be done, and in certain localities that are high and cold, where the stumps of a coppice thus worked, after a few cuttings become deformed and finally little better than dwarfed pollards, from which the sprouts come up with feeble attachment, and have scarcely the strength to resist the force of the winds or the weight of the snow and ice.¹

Hartig, whose experience has great weight in all questions upon forestry, recognizes the impossibility of maintaining a growth of beech coppice by the ordinary methods of working, and therefore proposes a special method, the details of which are as follows:

Supposing we have a beech woods, submitted to a working in periods of thirty years. He would advise a reservation of 100 trees per hectare at the first cutting. At the second period, when these had come to be sixty years old, he would have 2,000 trees reserved per hectare; and thirty years afterwards, that is, when the stumps were ninety years old, he would interrupt the regulation of coppice growth, and proceed to re-sow the woods by natural seeding. The oldest of the reserves, that is, the first 100, would then be ninety years old, and the second reservation of 2,000 would be sixty, and from these we might expect to find seed-trees enough for restocking the land for a new start. There would,

¹Many observations tend to show that the beech sprouts better from the stump in poor than in rich soils, which fact Hartig sought to explain in the following manner, but without claiming that it was the actual cause: "In a strong soil, the strong influx of the sap gives rise to buds of great vigor, but the bark of the beech, which is very hard, opposes the movement of the sap that comes first to the outer edge, which is pressed back, but finally, with difficulty, is able to get a start. When the soil is inferior, the sap is not so abundant, and the vegetation not so prompt. The buds growing more slowly find means to get through with more success."

A fact which confirmed Hartig in this opinion was the observation that, in good soils, the beech sprouts better when cut in the sap season, that is to say, when the stumps have lost a portion of their superabundant sap.—(L. & P.)

therefore, be three cuttings made in effecting this regeneration, the result of which would be to replace the old stumps by a fresh growth of seedlings, from which we might again proceed to treat the woods as a coppice growth, excepting always the application in due time of the above-described method.

Hartig mentions but one coppice of beech which had never been cut, and which at the first working had no stumps more than thirty years old. Such a forest is rarely met with; for we generally find them already cut over through several periods, and the stumps of very different ages. In such a case, it would therefore be best to reserve 2,000 trees per hectare when beginning the work of entirely new seeding. This number should not be always regarded invariably, but it should depend on the size of the trees and the number and condition of trees formerly reserved. It is, in short, sufficient if we establish a massive growth of trees that shall be able to serve the purpose of reseedling whenever the whole shall be in best condition for this operation.

On reflecting upon the means deemed indispensable for assuring the durability of beech in coppice, we are naturally led to the conclusion that this mode of treatment is not the proper one, and that it cannot be adopted without violence to the laws which govern tree-growth. If we attentively examine a beech coppice, especially one in which the stumps are rather old, we will always find void spaces here and there where the trees have died out from the decay of the stocks; and if these vacant spaces in the beech-woods have been filled, it will be generally by light sowings and oftener with the white woods, at least when artificial planting has not hindered these from coming in. It is in this way that the beech is little by little crowded off from the ground where it formerly reigned supreme. The method proposed by Hartig would doubtless be found sufficient to prevent such a result, but it offers but few advantages to the proprietor, since it causes the suppression of almost the whole of the products of the second period. In fact, the first cutting to obtain shoots, and then the trees of the second period left standing, would leave the greater part of the wood as trees for seeding, and to be worked after the method employed for the natural regeneration of a forest from the seed. After all this, we do not in the end recover the coppice-growth until we get a new and young forest.

It is only with great care, and by the aid of difficult and even burdensome methods, that beech-woods can be maintained in a proper coppice growth; while, on the other hand, we may easily perpetuate this kind by the method of natural seeding after a uniform order, and by rules easy to follow, and by which we may furthermore obtain within a given time the most considerable profits that this tree affords. We should, in short, whenever circumstances permit, treat the beech by the method of growing to full forests, and depend upon the reproduction by natural seeding at the end of the period.

In the old district of Morvan (Departments of Nièvre and Saône-et-Loire) and in different other regions in the South of France, they have adopted in beech coppice-woods a special mode of working, the efficacy of which has been proved by long experience, and which consequently merits the forester's attention. It is known as *furetage*,¹ and consists in cutting down from each stump only the largest of the trunks, when of a size sufficient for cord-wood, and at the same time carefully preserving the remainder till their proper time for cutting.

¹Literally, "stealing;" that is, robbing the stocks of a part of their growth at each time of cutting.

In the place left by the trunks thus cut, new shoots will spring up and prosper in the shade of their older comrades, until they, in turn, are taken to make room for still another crop. The stocks of a coppice thus treated will therefore present wood of two and even three ages, and the reproduction goes on to a very great length of time.

Usually the *foretage* coppice, all the wood, is cut over in this manner once in twenty-four or thirty years, according as the stocks bear wood of two or three ages, and the stocks are each visited two or three times with the ax during this period. For instance, if the time is thirty years, the woodman would come around once in ten years, and then leave at each time trunks ten and twenty years old, after he had taken those of the age of thirty years.

Since in this mode of working it is not customary to leave reserves, and since the trees cut are too young for bearing seed, the parasitic species and injurious vegetation are apt to gain upon the beech, and it is absolutely necessary to replace the decaying stocks by artificial planting. The method of *foretage* is also applied to other kinds of coppice-growth, especially the oak, but the results are not so satisfactory as with the beech. The sprouts of the oak require an abundance of light in the first years, and cannot accommodate themselves to the shade of the older shoots from the same stock, a circumstance that most favors the sprouts from the beech. It would seem, therefore, that this mode of cultivation should be limited to the beech with which it originated, and where its utility has been proved. In the other kinds a complete cutting off, with one or more thinnings within the period, appears to deserve the preference.

We find in a Journal of Forestry published by Hartig, a notice, communicated from the old Grand-Duchy of Berg, upon a method of working quite similar to that of *foretage*, and which seems to confirm its efficacy.

In this region, especially in the mountainous part [says the writer], there are quite extensive districts entirely covered with pollards, that are worked in the following manner:

When the tree planted has reached a diameter of from 3 to 4 inches, its top is cut off at the height of 6 to 8 feet, which gives the shoots the appearance of a new head. As soon as any of these shoots have grown to a diameter of 4 or 5 inches, they are cut off close to the trunk, making the section as smooth as possible. The trees which grow very rapidly are submitted to this *foretage* every two years, and those that are of slower growth every three or four years. The old pollards are replaced from time to time with new plantations, as they die out.

All the species,¹ even the beech, which a clean cutting would commonly kill out, support this treatment very well. We sometimes meet with pollard-beeches thus worked from an early age that have trunks 5 or 6 feet in diameter, in which the wood is still firm and very suitable for working.

The *foretage* of beech-coppice is, we repeat, worthy of the attention of foresters, and it is desirable that it should be more carefully studied than it has hitherto been by those who have occasion to apply the practice, to the end that they may more fully understand the conditions essential to success.

In this connection we may mention some general principles that apply to coppice-woods of every kind, in which dependence is placed upon

¹From what is here said we must not conclude that the opinion above expressed concerning the *foretage* of the beech is incorrect. We should notice the difference between the two methods. In the case of the trees planted as above described, they are sparse and therefore well exposed to the light and to the air in general; while on the other hand, where the woods grow in dense masses this fact has its influence, and in fact all the conditions of vegetation are entirely different.—(L. & P.) The item "All of the species," of course, needs modification, as it applies to none of the conifers that form a subject of cultivation in the region described.

the shoots springing from the edge of the wood within the ring of bark that surrounds it, and when properly attended to produce a new crop of wood. As a general rule these shoots are by so much the more abundant when the tree is cut close to the ground and where the bark is open and spongy in its texture. It is generally more successful with the kinds that send up sprouts from their tracing roots, and these sprouts often afford valuable trees. It succeeds well with most deciduous species except the beech, which presents difficulties that are mentioned in detail in the preceding pages. In some of the minor kinds it may be cut over at short intervals for procuring hoop-poles and other small wood, and often with great advantage. The period of cutting varies according to the species and many other circumstances, such as soil, aspect, elevation, &c. The uses to which such woods are most generally applied are for fire-wood and charcoal—in the case of the oak, for the production of bark for tanning purposes, and in some cases for wood used as mine-props, railroad-ties, and a multitude of other purposes. In cutting wood that is to be reproduced from the stump, care should always be taken to have the section smooth, at least around the line where the wood and bark join, and the top should be rounded so as to shed off the water that falls. This operation is best performed with a sharp adze. Where the top is left concave, the water thus detained tends to hasten the decay of the stump.

As for the season best adapted to the cutting of a coppice in order to secure a new and vigorous growth, it should not be done either in autumn or winter, because intense cold might alter the condition of the stocks, or even detach the bark as it was swollen by the rains and distended by the frost. It is also not advisable to cut during the sap season, as the stumps might be weakened by the profuse flow of the sap, which would prove a real loss, because the best growth of the new buds comes from the spring sap. When cut while the sap is flowing, the sprouts get only the summer sap, and they are less vigorous and are scarcely able to ripen their wood before winter. In short, this cutting in the flow of sap should never be tolerated, excepting in the oak raised for its bark, which can only be peeled in that season.

The best months for cutting coppice woods are February or March, or the beginning of April, in the climate found in France. It may be earlier or later in particular regions, according as the seasons are more or less forward, and as a general rule it should never be done when liable to be followed by extreme cold, and never in the sap season. In some mild climates and near the sea, or great bodies of water, where extreme cold is not liable to occur, the cutting may begin as soon as the leaves have fallen in autumn, and in the case of the broad-leaved species with evergreen leaves (*Quercus ilex*, &c.), as soon as the movement of the second sap has ceased.¹

The beech, when growing in a close forest, carries up its trunk in full proportions to a great height, as may be seen in the dense native forests in Michigan and to the south of Lake Superior, but when standing in open grounds and in hedge-rows, it spreads out horizontally to a great dis-

¹These principles apply in some cases where it is desirable to avoid the sprouting of trees that we wish to get rid of, and also in the trimming of trees, where we do not wish to be troubled by a new growth of sprouts. By selecting any time after the wood of the year has formed, such as the latter part of summer, or early in autumn, this end may be secured with good effect. In the crusade against the Ailanthus, in some of our cities, in which avenues have been cut down in the streets to get rid of the nauseating odor of the blossoms, a neglect of this forethought has multiplied the sprouts that it was desirable to destroy, where at another time of the year the destruction would have been complete.

tance, affording an abundant shade in summer, and often, from the persistence of the dead leaves, some shelter from the storms in winter. It is remarked by the editor of Evelyn's *Sylva*, that the beech delights in a chalky or stony ground, and that upon such land the bark is clear and smooth, a certain indication that the soil suits the tree. On account of its growing in soils where other species would not thrive, and the firmness with which it spreads its roots in the ground, it is well adapted for planting in bleak and exposed places, where shelter is needed from the winds; but for such plantations it should not be taken from a nursery upon a rich soil and in a warm exposure, because the contrast in the conditions and the injuries unavoidable in transplanting, will be too great for its endurance. The difference in the soil should in such cases not be great, but the rule still holds here as everywhere, that plants the best rooted are the most sure to survive. Upon the whole, it was advised that the trees in such cases should be planted from the seed in the places where they were to remain, of course giving them in the early years such protection as they require.¹ A contemporary of Evelyn adopts most of the facts presented by that writer, and remarks that the beech was at his time "altogether a stranger to most counties in England; and it is probable that there might be none here when the Great Cæsar denied that he found any. For many of these great woods of beeches may have sprung up after the felling of oaks; as it hath been observed of late years, that where the oaks hath been felled the beech hath succeeded, and that not only here and there a tree, but in many acres, and

¹*Hunter's Evelyn's Sylva*, 3d ed. (1801), i, 133. Evelyn, in speaking of the growth and uses of the beech, says: This tree planted in palisades, affords an useful and pleasant screen to shelter orange and other tender case trees from the parching sun, growing very tall, and little inferior to the horn-beam or Dutch elm. In the valleys, where they stand warm and in consort, they will grow to a stupendous precocity, though the soil be stony and very barren; also upon the declivities, sides and tops of very high hills, and chalky mountains especially: for though they thrust not down such deep and numerous roots as the oak, and grow to vast trees, they will strangely insinuate their roots into the bowels of those seemingly impenetrable places, not much unlike the fir itself, which, with this so common tree, the great Cæsar denies to be found in Britain, "*materia cujusque generis ut in Gallia, præter Fagum et Abietem*;" but certainly from a grand mistake, or rather that he had not traveled much up into the country. Virgil reports that it will graft with the chestnut.

The beech serves for various uses of the housewife. With it the turner makes dishes, trays, rims for buckets, trenchers, dresser-boards and other utensils. It serves the wheelwright and joiner for large screws, &c. The upholsterer uses it for sellies, chairs, bedsteads, &c. It makes shovels and spade-graffs for the husbandman, and is useful to the bellows-maker. Floats for fishers' nets, instead of corks, are made from its bark. It is good for fuel, billet, bavin, and coals, though one of the least lasting; and its very shavings are good for the fining of wine. Peter Cressentius writes that the ashes of the beech with proper mixture, is excellent to make glass with. If the timber lie altogether under water, it is little inferior to elm, as I find it practiced and asserted by shipwrights. Of old they made their *vasa virose mioriora* and *corbes messorial*, as we our pots for strawberries, with the rind of this tree; nay, and vessels to preserve wine in; and that curiously-wrought cup, which the shepherd in the *Bucolics* wagers withal was engraven by Alcimedon upon the bark of the beech. And a happy age, it seems:

—No wars did men molest,
When only beechen-bowls were in request.

Of the thin lamina or scale of this wood, as our cutters call it, are made scabbards for swords, and band-boxes, superinduced with thin leather or paper; boxes for writings, hat-cases, and formerly book-covers. I wonder we cannot split it ourselves, but send it to other countries for such trifles.

In the cavities of these trees, bees much delight to hive themselves; yet for all this, you would not wonder to hear me deplore the so frequent use of this wood, if you did consider that the industry of France furnishes that country for all domestic utensils with excellent walnut, a material infinitely preferable to the best beech, which is indeed good only for shade, and for the fire, as being brittle, and exceedingly obnoxious

also where no beech hath been near unto the place, *sponte sua veniunt*. Some places naturally produce them."¹

In speaking of the American species of the beech, Michaux remarks that the red variety (or, as he calls it, species) bears a greater resemblance to the European than to the white beech. It equals the latter in diameter but not in height, and as it ramifies nearer the earth, and is more numerously divided, it has a more massive summit and the appearance of more tufted foliage. Its leaves are equally brilliant, a little longer and thicker, and have longer teeth. Its fruit is only half as large, and is garnished with firmer and less numerous points. He also noticed an important difference in the wood. A red beech, fifteen or eighteen inches in diameter, would have three or four inches of sap, and thirteen or fourteen of heart, the reverse of that found in the white beech, in which the heart wood bore but a small proportion to the sap, sometimes not more than three inches in a tree that was eighteen inches in diameter. He regarded the red beech as stronger, tougher, and more compact than the white, and in Maine he found it used to some extent in ship-building and for hoops. It was used for shoe lasts, planes, tool handles, and the tops of hand carts for carting wood.

As to the time of cutting the beech, he says:

Experience has demonstrated the advantage of felling the beech in summer, while the sap is in full circulation; cut at this season, it is very durable, but felled in the winter, it decays in a few years. The logs are left several months in the shade before they are hewn, care being taken that they do not rest immediately upon the ground; after which they are fashioned according to the use to which they are destined, and and laid in water for three or four months. They are said to be rendered in this way inaccessible to worms.

The beech is very durable when preserved from humidity, and incorruptible when constantly in the water; but it rapidly decays when exposed to alternations of dryness and moisture. In Europe, where there are not as many trees as in North America with durable and elegant wood, such as the birches and the maples, we are depend-

to the worm, where it lies either dry, or wet and dry, as has been noted; but being put ten days in water, it will exceedingly resist the worm, to which, as I said, it is so obnoxious, that I wish the use of it were by a law prohibited all joiners, cabinet-makers, and such as furnish tables, chairs, bedsteads, coffers, screws, &c. They have a way to black and polish it so as to render it like ebony; and with a mixture of soot and urine, imitate the walnut; but as the color does not last, so neither does the wood itself, for I can hardly call it timber, soon after the worm has seized it, unless one sponge and imbibe it well with the oil of spike, where they have made holes. * * *

But while we thus condemn the timber, we must not omit to praise the mast, which fattens our swine and deer, and hath, in some families, even supported men with bread. Chios endured a memorable seige by the benefits of this mast. And in some parts of France, they now grind the buck in mills; it affords a sweet oil, which poor people eat most willingly. But there is yet another benefit which this tree presents us; its very leaves, which make a natural and most agreeable canopy all the summer, being gathered about the fall, and somewhat before they are much frost-bitten, afford the best and easiest mattresses in the world to lay under our quilts instead of straw; because, besides their tenderness and looselying together, they continue sweet for seven or eight years long, before which time straw becomes musty and hard. They are thus used by divers persons of quality in Dauphiny; and, in Switzerland, I have sometimes lain on them to my great refreshment. So is of this tree, it may properly be said,

The wood's an house, the leaves a bed.

Being pruned, it heals the scar immediately, and is not so apt to put forth again as other trees.

¹*Systema Agriculturae; the Mystery of Husbandry discovered.* * * * By J[ohn] W[orlidge] 1687, folio p. 92. Editions of this work were printed in 1669, 1675, 1681, 1683, and 1693.

The fact of alternate forest growths appears to have been as familiar known two centuries ago as at the present time. The absurd idea of spontaneous generation even finds advocates at the present time, among those who fail to recognize in the operations of nature sufficient agencies for the diffusion of seed, where a new growth thus comes in to replace one of different kind that has been taken away. Of course when carefully studied, the winds, running streams, and animal life in various forms, will be found the principal agencies where the seeds themselves have not been preserved for some time in the soil.

ant on the beech for a greater variety of uses. It is employed for tables and bedsteads, screws, rollers, pestles, dishes, wooden shoes, corn shovels, &c; in the north of France it is taken for felloes of wheels, and it was formerly used instead of pasteboard in book-binding. In the valley of Saint Jean pied-de-port, in the Pyrenees, oars are made of it to supply the neighboring ports of the ocean. While the wood retains a portion of its sap, they are pliant and elastic, but for this use no tree can stand in competition with the black ash of the United States. Though the beech is rapidly consumed, it is highly esteemed as a combustible, and its ashes are rich in alkali.

In certain cantons of Belgium, particularly near the village of St. Nicholas, between Ghent and Antwerp, very solid and elegant hedges are made with young beeches, placed seven or eight inches apart and bent in opposite directions, so as to cross each other and form a trellis with apertures five or six inches in diameter. During the first year they should be bound with osier at the points of intersection, where they finally become grafted and grow together. As the beech does not suffer in pruning, and sprouts less luxuriantly than most other trees, it is perfectly adapted to this object.

In France and Germany an oil is extracted from the beech-nut which is next in fineness to that of the olive. The forests of Eu and of Cr  cy, in the Departments of the Oise, have yielded in a single season more than a million sacks (about 2,000,000 bushels) of this fruit, and in 1779 the forests of Compi  gne, near Verberie, Department of the Somme, afforded oil enough to supply the wants of the district for more than half a century. * * * The oil is abundant only when the fruit is perfectly ripe. The season for extracting it is from the beginning of December to the end of March; if the operation is longer delayed the nuts are liable to be injured by the warmth of the season.

The skin is commonly ground with the kernel, but as the product in this way diminishes a seventh, it would be more advantageous to separate them, which might be done in a flouring mill properly adjusted. The kernel should be immediately reduced to a paste by a vertical stone, or by a pestle-mill. As the paste becomes dry in the process, water is added in the proportion of one pound to fifteen pounds of fruit, to prevent its being impaired by the heat.

The paste is sufficiently reduced when the oil is discharged by the pressure of the hand. It is submitted to the press in sacks of coarse linen, of wool, or of hair, and the force is gradually applied and long continued, so that the oil may be completely distilled; three hours at least, are required in an ordinary press. To prepare the paste for a second pressure, it is pulverized, a proportion of water being added smaller than at first, and the whole is warmed by the careful application of a moderate heat. A *wedge-press* is commonly employed in the second operation.

With skill in the process, the oil is equal to one-sixth of the fruit. Its quality depends upon the care with which it is made, and upon the purity of the vessels in which it is preserved. It should be twice drawn off during the first three months without disturbing the dregs, and a third time at the end of six months. It arrives at perfection only when it becomes limpid, several months after its extraction. It improves by age, lasts unimpaired for ten years, and may be preserved longer than any other oil.¹

In a memoir upon the various uses of the beech, published by the French Forest Administration, in connection with the Paris Exhibition of 1878,² we find a large amount of information concerning this tree, from which we derive the following facts:

The author of this memoir, after noticing the general diffusion of the beech in France, where it is one of the most common and the most useful of trees, remarks that the various uses to which any wood may be applied depends upon its anatomical structure, and upon certain properties resulting from this special organization. He proposes, therefore, to first consider the peculiar characteristics of the timber, and then to inquire as to the effect of forces variously applied, and as to how it is affected by atmospheric influence. An examination in respect to these will lead to the suggestion of the various uses, to which this wood may be applied.

The structure of the beech is very homogeneous, its grain is close, and it is easily worked. When exposed to pressure in the direction of its fibers it is found to be superior to the oak, if in a state of ordinary dryness, but if very dry it is less, but still equal to the ash, and in all con-

¹ Michaux's *Sylva Americana*, iii, 23.

² *Notice sur les divers Emplois du H  tre*. Par M. Croizette-Desnoyers, Grand G  n  ral des For  ts. Paris, 4to, p. 103.

ditions superior to the alder. When a force is applied as a traction it is equal to the oak. As to its strength, when a force is applied across the length of the grain, it is found to be sufficiently strong for most uses, especially if the depth of the piece is greater than the width. But these qualities are not alone sufficient to warrant us in saying that this timber is proper for construction¹ until it is known how durable it is, but here, unfortunately, it is found that, when alternately exposed to dryness and moisture, it is liable to split, warp, and suffer from the attack of insect-larvæ. It will check and shrink irregularly while seasoning, on account of the exterior layers of the wood drying and shrinking more than those within. It is to be noticed that these faults do not exist in wood that is kept always under water, in which it is found to last for a very great length of time.

This wood is therefore not suitable for carpenter's timber-work, in pieces of large size; but it is eminently suited for marine structures, and it has been used for many years as pile timber, in constructing dykes at the ports of Havre, Rouen, Honfleur, Basse-Seine and l'Océan.²

Its resistance to a crushing force, allows it to be used for railroad-ties, where it will practically support a rolling weight of five kilograms per square centimeter. Full information will be given concerning the methods employed for rendering it more durable when thus employed.

Such are the uses to which the beech may be applied in large constructions; it is more particularly in manufactures that it finds the most numerous and varied uses. As it splits very readily, it is used in great quantities every year for making wooden-shoes, and all kinds of articles requiring elasticity and strength. When sawed it is used by cabinet-makers, inlayers, carriage-makers, packers, upholsterers and the makers of organs and pianos. It is found proper for making hames and saddle-trees of harnesses, ox-yokes, wheel-felloes, hubs, spokes, and other parts of wagons, and for various agricultural implements, such as plows, harrows, rollers and thrashing-machines. It turns smoothly, and is used for tool-handles of all kinds, chairs, household furniture, and bobbins for milking laces. It is used for grain-shovels, grain-measures, brushes, boxes, the wooden part of bellows, &c., and it makes an excellent fuel.

The following table shows the total annual production of beech timber in the forests of France that are under state regulations :

| Uses. | Cubic meters. | [Cubic feet.] | Per cent. |
|--------------------------------|---------------|---------------|-----------|
| Firewood..... | 1,023,159 | 36,117,513 | 80.0 |
| Construction: | | | |
| Railroad ties..... | 74,854 | 2,642,366 | 5.5 |
| Mine-props, carpentry, &c..... | 5,164 | 182,289 | 0.4 |
| Industries: | | | |
| Sawed wood for market..... | 48,315 | 1,634,920 | 3.5 |
| Split wood..... | 13,004 | 459,041 | 1.0 |
| Wooden shoes..... | 63,234 | 2,232,161 | 5.0 |
| Carriage work..... | 12,057 | 425,612 | 1.0 |
| Turnery..... | 8,210 | 289,813 | 0.6 |
| Various other industries..... | 38,226 | 1,349,778 | 3.0 |
| Total..... | 1,284,223 | 45,333,493 | 100.0 |

¹ According to the author under notice, the use of beech as a building timber in France is at present limited to the two mountainous regions of Ariège and Basses Alpes, where its consumption is entirely local and so limited that no particular dimensions have been established for getting it out for sale.

² For these uses, the timbers should be straight and not be less than 8, nor more than 14 meters in length, with a diameter of from 0^m.30 to 0^m.45, between which limits all dimensions are received. At Havre, alone, they take pieces that are 16 meters long and half a meter in diameter. It is commonly used without antiseptic preparation, and the consumption is increasing. The price is 30 francs per cubic meter on the place where cut.

In the use of beech for railroad ties it is to be noticed that wood thus employed is subjected to conditions unfavorable to its durability; for, besides being exposed in a soil alternately wet and dry, it is required to bear the enormous weight of trains passing over it, and it should be able to hold the spikes that are liable to loosen from decay. In its fresh condition the beech would answer most of the requirements, excepting that of durability, and before being used it is necessary to subject it to a process that preserves it from speedy decay.

Two modes of preservation of the beech ties have been employed, one proposing to expel the juices within that tend to hasten its decay, and to substitute in their place an antiseptic substance, while the other is applied only to the surface, without penetrating the interior. The first is the more rational, and is applied by the process invented by Dr. Boucherie, in which the sulphate of copper is forced into the wood, usually under a pressure of about one kilogram to a square centimeter (14.19 pounds to a square inch) of the section, and is affected by placing the vessels containing the solution upon a scaffold about 10 meters high. The solution, admitted at one end, presses out the sap, which first appears pure—then mixed with the sulphate of copper, and when the operation is continued a sufficient time nothing but the solution comes through. The time required to secure saturation depends upon the dryness of the wood, its size, and temperature, but it is at least five hours. This very rational method can only be applied to wood newly cut, and with the bark still on; for if the logs are peeled the solution will press out on the sides, and if too dry it will not penetrate easily, unless the pressure is increased to an enormous degree. The amount of sulphate of copper introduced into wood in the log amounts to 5.5 kilograms (12.1 pounds) to a cubic meter of the ties, and the strength of the solution is about a pound to eight gallons of water. The amount of the sulphate absorbed is determined either by a chemical analysis, or, in the yard, by means of a reagent consisting of 90 grams of the ferro-cyanide of potassium dissolved in a little water, which is applied by a pencil-brush to the surface of the wood. The process is deemed to have been well done if this test gives the very bright red color, but if the tinge is rose-colored the preparation is incomplete.

The northern and eastern companies buy their wood in the log, of two or three ties in a piece, and inject it upon their premises, after which it is fashioned into shape by a saw, the process costing them about a franc for each tie.

To expedite the preparation, by applying it to a great number of pieces at a time, the ties are first wrought into shape (except transverse and longitudinal sawing) and then exposed in a close vessel, first to a partial vacuum and then to pressure. This is done by placing the ties in a cylinder, from which the air is expelled by a current of steam, and then an exhaustion secured that ought not to show a pressure of more than 6 centimeters (about 2.36 inches) by the mercurial gauge. This tension is kept up long enough to remove from the wood its excess of moisture and to release the gases that it contains. The cylinder is then filled with the solution, at a temperature of about 50° C. (122° F.) and the process is gradually urged, until a pressure of from four to eight atmospheres is obtained, and this is kept up by the aid of compression pumps, until the wood is thoroughly penetrated, which should not require less than half an hour.

The results are judged by sawing in two a piece of twice the length of a tie and of double the thickness, and applying the ferro-cyanide of potassium test as above described. The solution used in this case is

2 kilograms (4.4 pounds) of the sulphate of copper, to a hectoliter, or 20 kilograms to 1 cubic meter, (44 pounds 1.5 ounces to 264.17 wine gallons) of water, and from 200 to 250 liters of the solution is absorbed by a cubic meter of the ties. This process is more expeditious than the former, because 200 ties can be operated upon at a time, but it requires a more expensive establishment, and the results are less complete. Nevertheless the process in close vessels, on account of its convenience and expedition, is much employed, notwithstanding its defects, and it can be used at a cost of about 70 centimes per tie.

The sulphate of copper is not the only substance employed in preparing beech ties. They sometimes use creosote, a heavy oil of about 200° obtained in the distillation of coal-tar, on account of the facility with which it penetrates and fills the wood. It has not the serious fault of the sulphate of copper, in decomposing the rails or spikes that come in contact with it, and of forming thereby a sulphate of iron that acts rapidly on the wood. We should, however, remark that its superiority has not yet been fully established.

The injection of creosote is effected by the same process as that of the sulphate of copper, and it costs more, on account of the higher price of the material used, amounting to 90 centimes for each tie. The Eastern Railway creosote most of the ties that they use.

The methods that have for their object to preserve the outer surface of the wood, without penetrating through it, are various. One is by the immersion of the ties in a hot solution of the sulphate of copper at 60 degrees, which is done in great tanks communicating with a boiler, from whence the steam is allowed to issue till it raises the solution to 60° centigrade, (140 F.) The solution contains about 2 kilograms of the sulphite to a hectoliter of water (4.4 pounds to 26½ gallons.) The solution is first made separately, and then poured into the tanks, until the desired strength is obtained, as shown by the hydrometer. The ties should be kept not less than two hours in the solution, at the temperature above mentioned. This scalding impregnates the wood only to a very little depth, in fact one that can scarcely be measured, but it is enough to protect the wood from atmospheric influences. The sulphate should be introduced into the wood to the extent of at least 11 pounds to a cubic meter of ties, and costs 55 centimes per tie. The results of the process are tested with the ferro-cyanide of potassium as already described.

By another process the surface is carbonized to a slight depth, as a protection from decay, and for effecting this various methods are used.

By the *Hugon process* a jet of air from a forge-bellows is made to pass through an oil-flame, which causes a long jet of flame, against which the wood is passed upon a sliding frame adapted to this purpose. Besides its considerable expense in apparatus, this process has the inconvenience of requiring a considerable amount of hand labor, because the wood has to be passed six times before the flame, and this requires a considerable time. In fact, not more than 200 to 250 ties can be prepared in this manner in a day of ten working hours.

The *Ravazé process*, which is now employed for carbonizing the outside of ties, consists in passing them through a cylinder some 4 meters long and 0.60 in diameter, lined with fire-brick, and placed in connection with a fire of petroleum or coal-oil at one end, and with a chimney at the other, of sufficient height to secure a draft of the flame through the whole length of the cylinder. The ties are passed through this flame on an endless iron chain, moved by steam power, and as soon as they enter they take fire and burn while passing through, so as to furnish in part the fuel necessary for their carbonization, which is com-

pletely secured by the time they have passed through the burning gases of the cylinder. The speed of the endless chain is so regulated that the ties have just time to receive the desired amount of charring, which is about two minutes to each tie. The flame is extinguished by a jet of water constantly running. This process is employed by the Orleans Company, and by many others, and admits of the preparation of from 900 to 1,200 ties a day, at a cost of only 30 centimes apiece.

Finally, a late improvement, destined without doubt to give excellent results, consists in the immersion of the carbonized tie after coming from the cylinder, in a bath of coal tar heated to 80 or 90 degrees C. (176° to 194° F.), when the dilatation of the wood, so highly heated in the carbonizer, admits of the penetration of the coal-tar, to the extent, on an average, of 2 kilograms (4.4 pounds). This immersion costs but 30 centimes apiece, and presents important advantages.

The cost by these several processes may be compared as follows:

| | Francs per tie. |
|---|-----------------|
| 1. By injection : | |
| Boucherie process | 1. 00 |
| In close vessels, by vacuum and pressure | 0. 70 |
| By creosoting | 0. 90 |
| 2. By external preservation : | |
| Immersion in a hot bath of sulphate of copper | 0. 55 |
| Carbonization of surface alone | 0. 30 |
| Carbonization and immersion in coal-tar | 0. 60 |

Beech ties, when injected, will last from nine to twelve years.

The trees should be of good quality, and in full growth, without punctures, rotten spots, defective knots, frost cracks, fissures, shakes, or other faults. The wood called *red*, that is to say, passed its prime, ought not to be used. For beech ties that are to be injected it is absolutely necessary that the trees should not have any noticeable defects, because the absorption of the antiseptic materials will not then be complete, and its preservation is not so well assured.

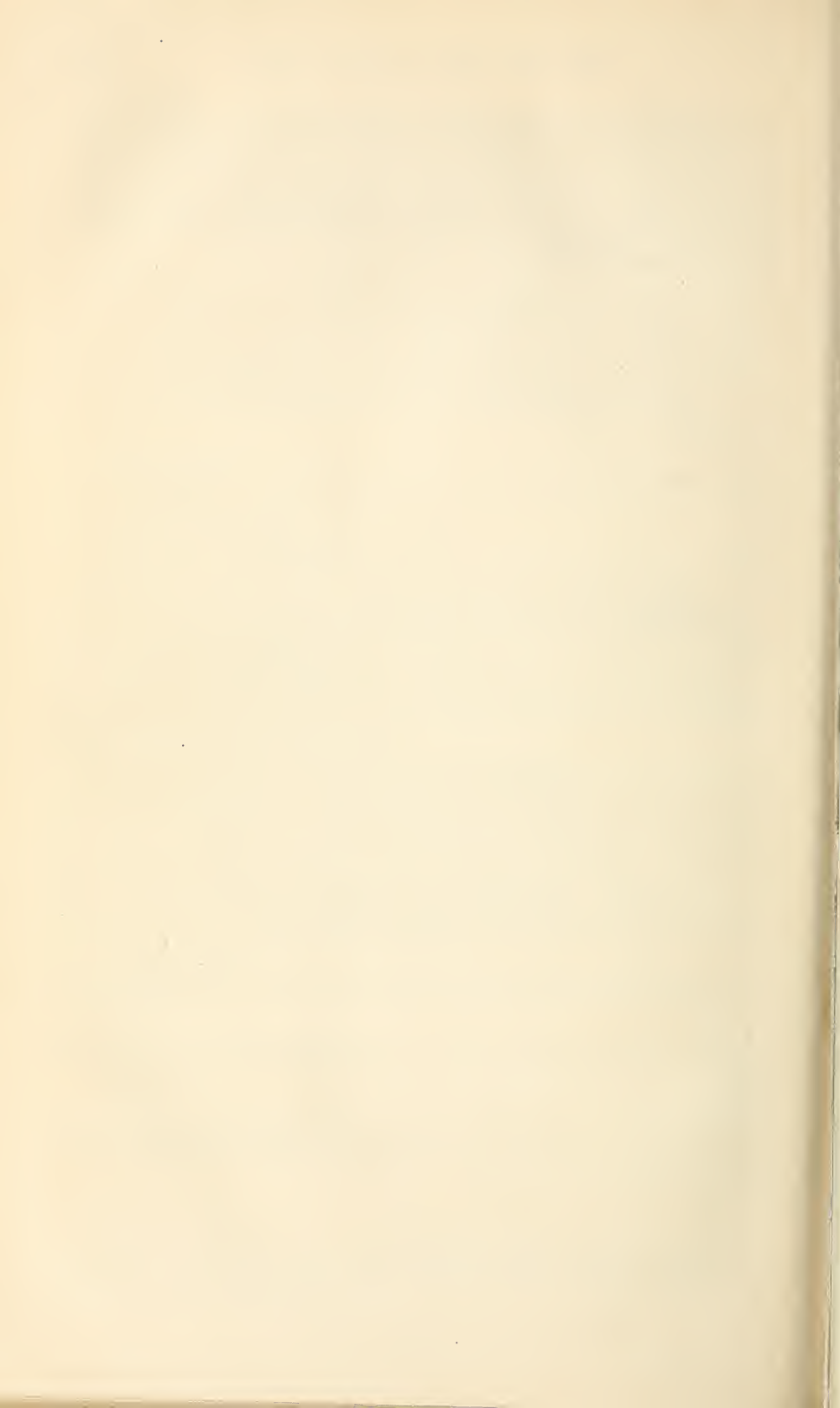
The trees should not be less than 0.25 (9.84 inches) in diameter; as for greatest diameter there is no limit, but they seldom get trees more than a meter and a half around. They often take wood for ties in the branches. The waste in working is variable, according to the size of the trees, but is not less than 10 per cent. of the volume in the log. Companies often buy the wood in the rough, and sometimes the ties are worked upon the ground and sold there by the contractors. When delivered on the ground where got out, beech ties are worth from 3.25 francs to 3.50 francs apiece. They average 0.087 cubic meters, or from 10 to 12 ties to a cubic meter.

The balance-sheet, in getting out ties for the market, may be therefore stated as follows:

| | Francs. |
|--|---------|
| Ten ties will set at 3.5 francs apiece | 35. 00 |
| The waste, at 6 francs the stéré, is worth | 1. 50 |
| Total receipts | 36. 50 |
| Cost of working at 60 centimes each | 7. 20 |
| Drawing to the stations at 36 centimes | 3. 60 |
| Cost of a cubic meter of wood | 22. 00 |
| | <hr/> |
| | 32. 80 |
| | <hr/> |
| Balance | 3. 70 |

The beech is worked into railroad ties in a great number of the departments, and 74,854 cubic metres are furnished annually from the forests under the state care.

A railroad tie must have a certain stability in its mass. If the width of the track is a meter and a half, the tie should be not less than 2.^m60 in length; its breadth should be sufficient to have enough bearing upon the ballast, and its thickness should be some centimeters more than the length of the spikes, and not less than $5\frac{1}{2}$ inches. The dimensions best suited for use as railroad ties depend upon the weight of rails, amount of use required, weight of trains, nature of the ballast, and other circumstances.



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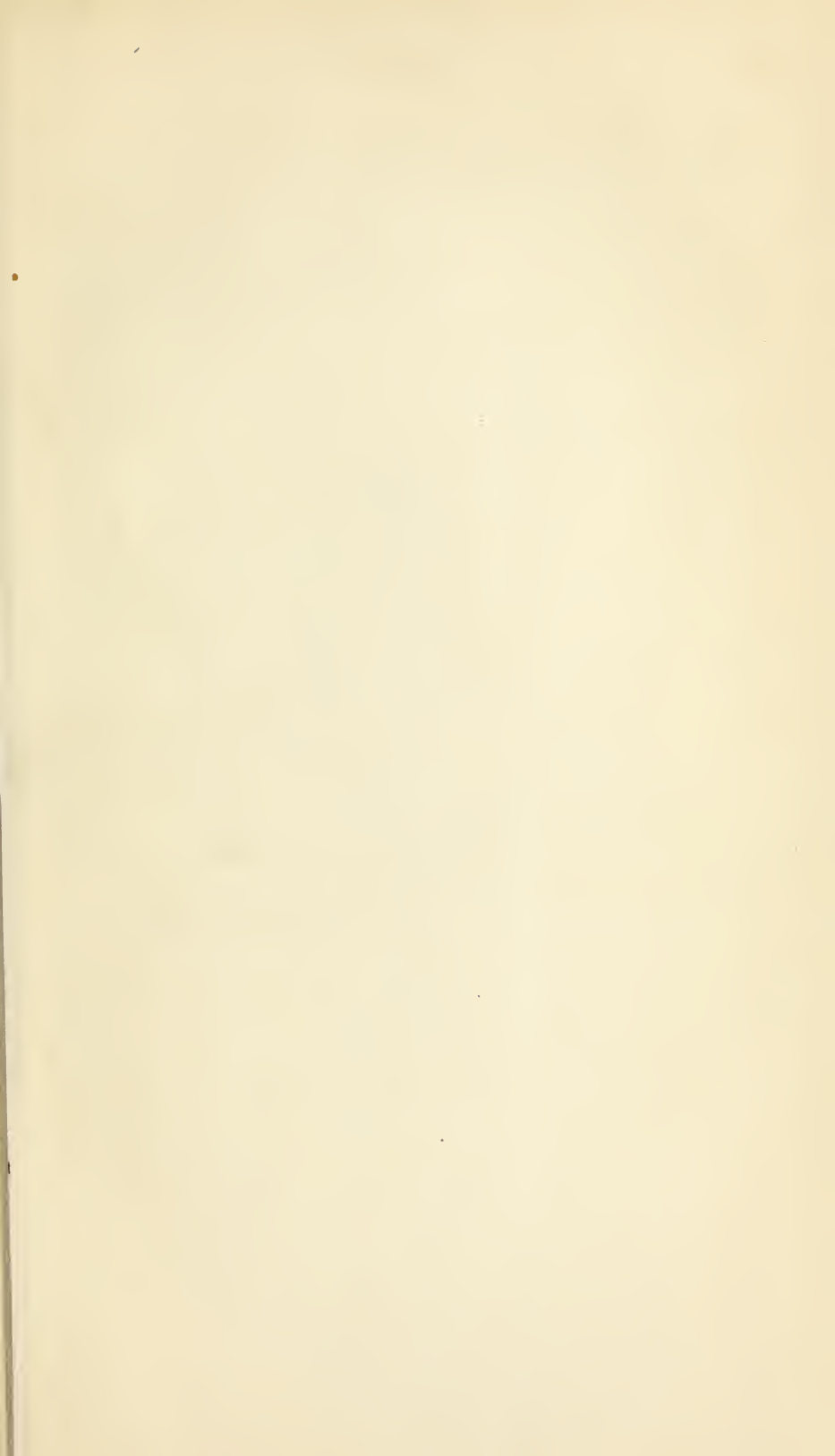
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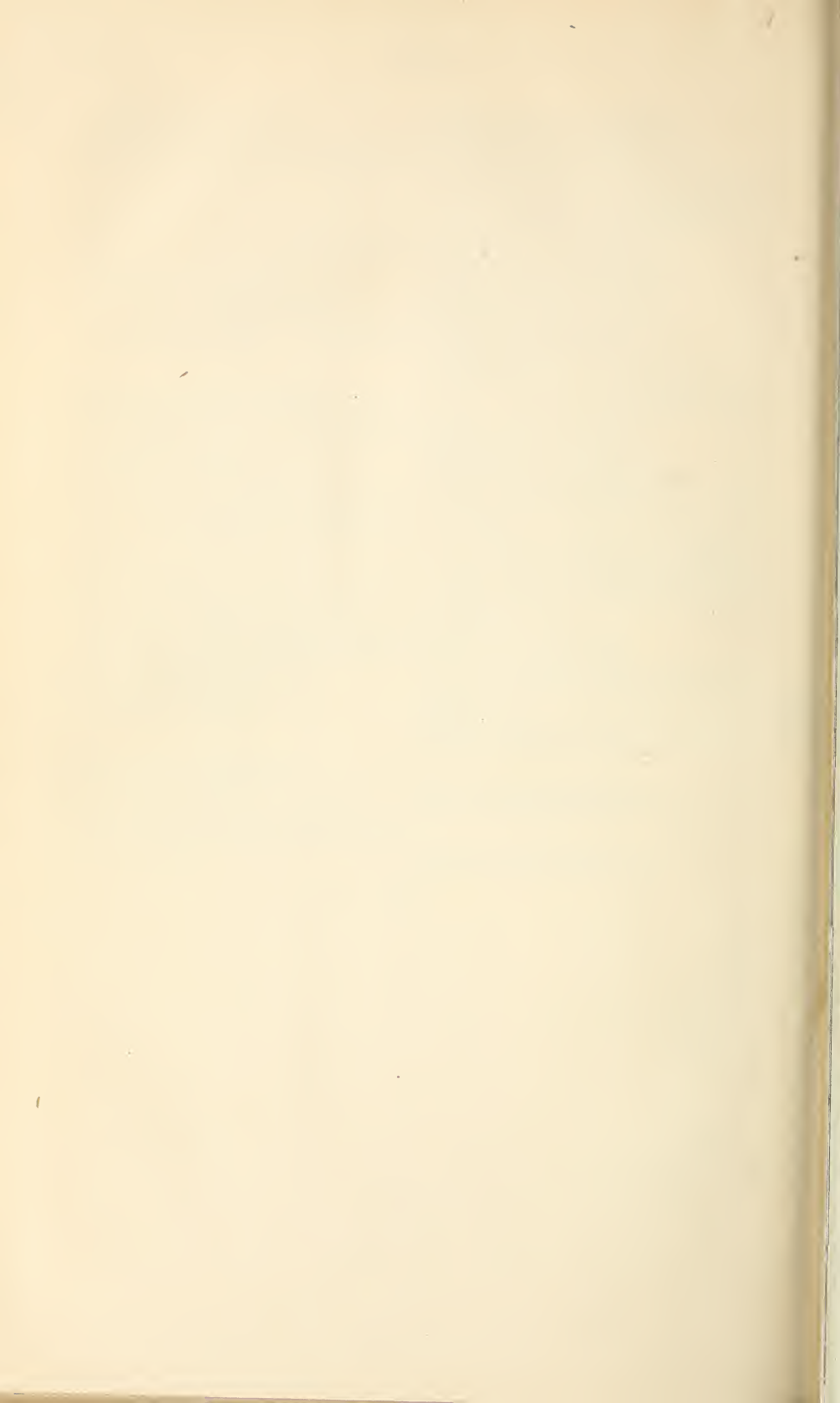
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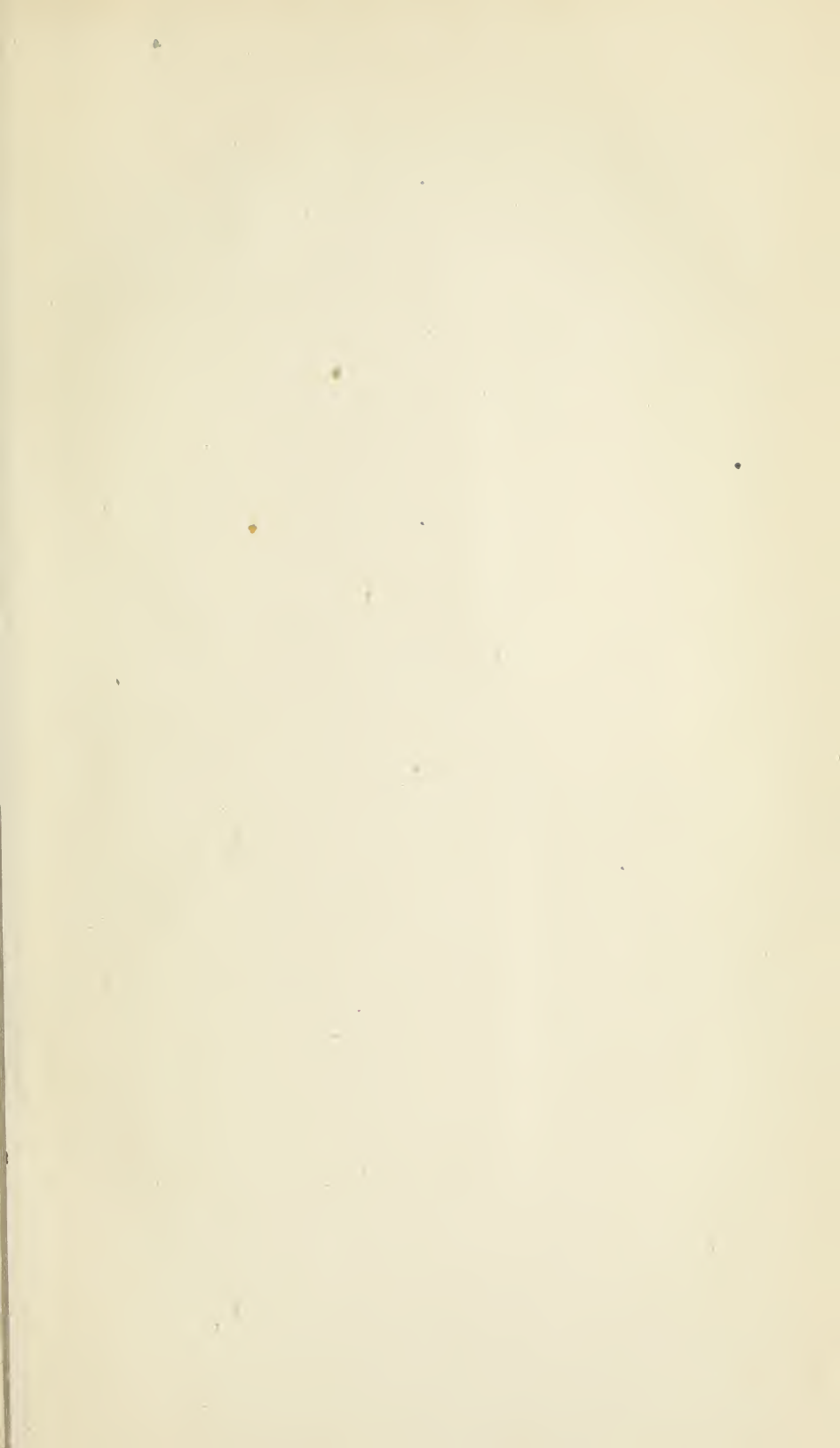
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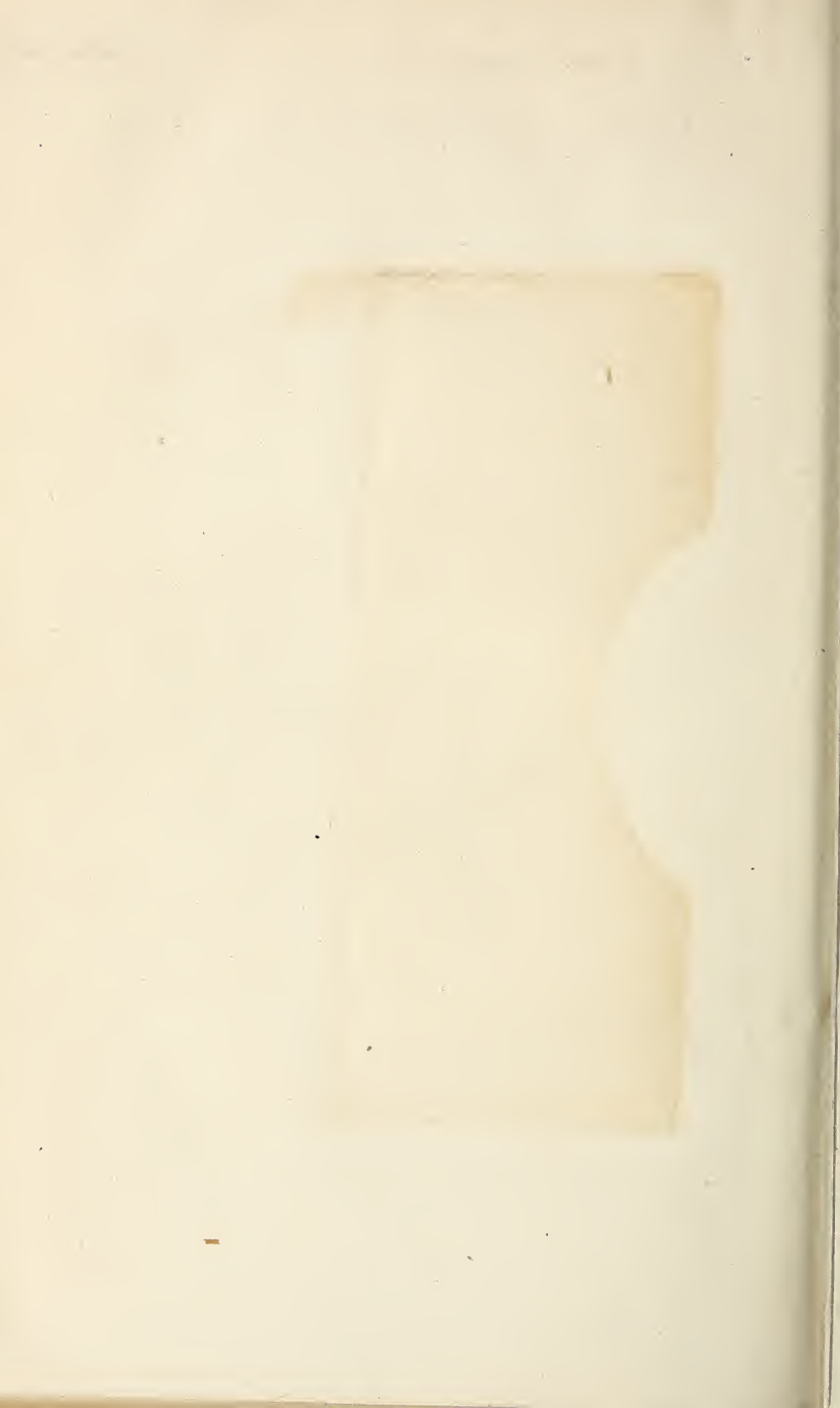
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